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PREHISTORIC MAN IN THE EASTERN MEDITERRANEAN.

THE purpose of these notes is to summarise the results of recent research among the prehistoric peoples and civilisation of the Eastern Mediterranean ; especially in so far as these prepare the environment for the first great civilisation of Europe, namely, that of Greece, and fill the chronological gap, and explain such communication as existed, between this and the equally "historic" but far earlier civilisations of the Euphrates and Nile Valleys.

A strictly "Historic" Age on the shores of the Ægean Sea, or in fact in the Eastern Mediterranean at all, cannot be said to begin before the seventh or at earliest the end of the eighth century B.C. ; and everything before this point would certainly have been classed as "Prehistoric," but for the fact that, until quite lately, the preceding centuries have been interpreted wholly in the light of a voluminous Greek tradition, which is still accepted in many quarters as fundamentally historical ; though now with wide reservations everywhere. Consequently prehistoric archæology and ethnology have here come into existence as accessory and supplementary studies, and the data of the literary tradition have been used, as was inevitable, as a working hypothesis ; which, it is only fair to say, has served its purpose fully as well as there was every reason to expect. Consequently again, any account of the more recent and more

strictly anthropological work in this field must stand, if it is to be intelligible, in close relation with the data and assumptions, which have so mainly determined its course.

ANCIENT TRADITIONS AND MODERN INTERPRETATIONS.

1. The data upon which Greeks of the sixth and early fifth centuries relied for the reconstruction of their own history consisted wholly of traditional anecdotes, appended to traditional genealogies, or grouped, in more or less organic connection, round equally traditional events, such as an invasion of the Troad, or an exploration of the Euxine, or the adventures of a typical navigator like Odysseus. Many of the lays in which these anecdotes were preserved can be traced with some probability to their places of origin, which range from Cyprus to the islands off the west coast of Greece, and from Thessaly and the Troad to Crete. All profess to represent the civilisation of the *Ægean* area at a period removed by several centuries from the point at which the Hellenic world emerges into history; and the traditional chronology of historical Hellas went up to an era which is slightly later, but approximately contemporary with the latest episodes of the Epic poems. Now though the lays which display the greater literary skill and the maturer idiom give a less vivid and more conventional picture; and though occasional allusions occur to customs and beliefs which are characteristic of Hellenic culture, those others which Greek tradition reckons primary, namely, the *Iliad* and the *Odyssey*, are obviously at close quarters with their subject; and if there is one thing certain about the civilisation of the "Homeric Age" thus described, it is that it differs in nearly every important feature from that of the "Hellenic Age" of historical Greece.

2. The Greeks, in fact, themselves regarded their earliest literature as antedating the chronological limits of their history, and already perceived that they belonged to a different order of things. In particular, the ethnography of the *Ægean*, preserved in an admittedly late and degenerate lay, differs uniformly from that of historic Hellas as far back as it can be traced, and those names are almost

absent by which the Greek race was denoted historically ; by its western neighbours as Ἕλληνες, by its eastern neighbours as Ἰάονες (Javan). This inconsistency was attributed by the Greeks themselves to a period of invasion and migration analogous to that which broke up the Græco-Roman civilisation of the Mediterranean. Dorian, Thessalian and Bœotian mountaineers were represented as forcing the barrier, or descending from the highlands, of the Balkans, bringing the old established "Achæan" civilisation to an abrupt close, and reducing the Ægean, and mainland Greece in particular, to a chaotic and barbarous state, the recovery from which is the dawn of the historical Hellenic genius.

3. Some facts within their own experience went to confirm this view. Here and there tribes retained the names and the mode of life of the earlier age ; or a noble family professed to trace its descent beyond the limits of current genealogy, and to identify itself with a Royal house of Achæan princes ; and here and there ruined fortresses remained, or ancient tombs had been disturbed, which seemed to confirm the description of Achæan splendour in the ballads.

4. Thus much had been established from the beginning of Greek History onwards, and had not been seriously shaken by successive attempts to discredit the traditional view. The theories that the lays are comparatively late compositions, and that they stand in no close relation to a pre-Hellenic age ; that the Achæan Age is an invention, and the Period of the Migrations a hypothesis to explain its inconsistency with the facts of historical geography, all prove too much, and may be met with *argumenta ad hominem* from the same traditional data. No literary critic of the Epic has yet purged himself of a sediment of traditional preconception ; and, in proportion as one or another has attempted to do so, he has been reduced to a merely agnostic position.

5. Further, until very recent years, every attempt which was made to elucidate the civilisation of the Homeric Age by the monuments of early Greek civilisation rested upon

the assumption that the representations of dress, armour, etc., of the sixth, fifth and fourth centuries B.C., were valid illustrations of poems which at the latest belonged to the seventh, and on an average were assigned to the ninth or tenth century. The reason of this was that Homeric subjects in Greek art are uniformly furnished with accessories of the age of the artist, and that until the study of Classical Antiquities began to be infected with the "evolutionary notions" which had already long been current in all other departments of Ethnography, the attention of students of Greek art and culture was strictly confined to mature and decadent art; everything which could not be assigned to a century subsequent to the fifth was either dismissed as barbaric, or discounted as a "Phœnician importation"; the part which "Phœnician" fables, ancient and modern, have played in the historical study of the Mediterranean area will be considered briefly later on. Such, for example, was the received opinion—so far as there was one—of such discoveries of pre-Hellenic culture as those of M. Fouqué's expedition to the Island of Santorin (Thera, 1862), where, in the course of a geological investigation, a primitive settlement was found under a thick bed of volcanic debris, or of those of MM. Salzmann and Biliotti (1868-71), who in searching for antiquities in Rhodes found at Ialysos, for the British Museum, a magnificent collection of early vases which are now known to be Mykenæan, and second only in quality and variety to those from Mykenæ itself. The Santorin settlement was simply taken to confirm the legend of the Phœnician colony of Kadmos (Hdt. iv., 147), and the vases from Ialysos were explained as the barbarous but immediate predecessors of those from Kamiros, were classed with them as "Græco-Phœnician," and were referred to the seventh century, in spite of the absence of Egyptian objects of the twenty-sixth Dynasty, and the presence of objects of the eighteenth: a view which in certain quarters is not yet quite extinct.

6. It was not till 1871 that Dr. Heinrich Schliemann was enabled to execute his lifelong ambition of testing with the spade the Greek tradition that the site of the Græco-

Roman town of Ilion was also the site of Homer's Troy. The tradition had indeed been sorely handled by Demetrios of Skepsis, a local antiquary of the second century B.C., on the geological ground that the Plain of Troy is of recent alluvial formation; and by other critics on the score of inconsistency with the Homeric narrative. But the Bali Dagħ, the site suggested by Demetrios, and in fact the only alternative, is far more inconsistent, and is put absolutely out of question by Dr. Schliemann's discoveries. In successive seasons (1871-3, 1876-82) he laid bare not one, but six cities, built one after another on the same site, and forming an accumulation of walls and debris some thirty feet deep; and, among these, two additional layers have been distinguished in the confirmatory excavations of Dr. Dörpfeld, 1892-94. The latter, however, indicate that Dr. Schliemann's earlier work was not, from the circumstances of the case, sufficiently closely watched throughout, and that in some cases objects were probably picked up at lower levels than those to which they properly belong. In particular, it is not clear that the *cache* of jewellery and plate known as the "Great Treasure of Priam" was *not* hidden originally in a shaft of some depth.

7. Dr. Schliemann claimed as the Homeric Troy the Second Town from the bottom, which had perished by fire, and in which the "Great Treasure" was found. But the Sixth Town, which Dr. Schliemann described as Lydian, was shown by Dr. Dörpfeld in 1892-93 to be larger and more important than was at first supposed, and to correspond closely with the remains found subsequently at Mykenæ and elsewhere.

8. With the same purpose in view of testing the Homeric tradition, Dr. Schliemann proceeded in 1875-6 to excavate the citadel of Mykenæ, in the Peloponnese, the traditional centre of the Achaian feudal confederacy. Here the results were equally unexpected, but no less confirmatory of the legend. A civilisation was brought to light wholly un-Hellenic, but far from barbarous; greatly in advance of all but the latest layers of Hissarlik, and presenting already the marks of decadence after a protracted

career. The pottery, the personal ornaments, and in fact the whole cycle of the art, were at once recognised as identical with those of Ialysos, while the stone-fenced burial-place discovered just within the "Lion Gate" of the citadel, with its six "shaft graves" and their enormous wealth of gold vessels and ornaments, seemed ample confirmation of the legendary wealth of "golden Mykenæ," and was proclaimed, in the first enthusiasm of the discovery, as the tomb of Agamemnon himself. The further researches which have been made almost continuously from 1886 onwards by M. Tsountas for the Greek Archaeological Society have confirmed in all essential points the first general impression, but the discovery of later tombs in the lower quarters of the town has made it possible to trace an order of progress and to extend the limits of the period.

9. Subsequent excavations at Tiryns and Orchomenos by Dr. Schliemann, and on a number of other sites in Greece and the Ægean Islands by the Greek Archaeological Society and the foreign Institutes in Athens, have demonstrated that this civilisation, which has acquired the provisional name of Mykenæan, is widely represented in the Ægean area and especially in its southern part; that its influence extended over the Central and Eastern Mediterranean from Sicily to Cyprus; that it penetrated, intermittently at all events, into Egypt, where its apparition can be approximately dated, and whence it imported much, and borrowed somewhat, but without losing its own individuality; and, most striking of all, that, after a long period of apparently continuous maturity, it falls into a sudden decadence; leaving, to all appearance, just the same gap between itself and the first traces of Hellenic Art, as we have noted already, on the literary side, between the Homeric Age and the beginning of Hellenic History. It should be further noted, however, that in the last few years many facts have come to light, especially in Attica, in Crete, and, most of all, in Cyprus, which seem to indicate how that gap may eventually be filled. It is from the pottery, almost without exception, that the leading indications have been derived. Fragments of baked clay

are practically indestructible, even though the vessels which they composed have been shattered. Moreover, all the unrefined varieties of clay, and many even of the best levigated, present features by which their place of origin may be recognised. Consequently, in this material, modelling and decoration can be perpetuated as in no other way; and, what is more important, the intrinsic worthlessness of earthenware has often preserved it from the displacement and destruction which almost inevitably overtake objects of gold, bronze, and marble. The resulting preponderance of ceramographic references in the bibliography which follows these notes must therefore be taken as indicating the character of the evidence which is most accessible, and of the method which has actually proved most fruitful: not that the pottery really took so large a place in primitive art as might be inferred from its actual abundance, and its scientific importance.

10. Consequently the study of Early Man in the *Ægean* has entered within a few years on a new phase, and presents the following problems: (1) To reconstruct in detail the history of the Mykenæan civilisation; its origin, its character, range and influence, and its decline; (2) to investigate the causes of that relapse into barbarism, which both literature and archæology attest; (3) to determine the ethnological position of the race, or races, who originated, maintained, and overthrew it, and their relationship with the historic inhabitants of the same area; and (4) as a special study, to determine the relation in which the Hellenic traditions of the Achæan Age, and the lays in which they were preserved, stand to the civilisation which they certainly seem to commemorate, and which owes its discovery simply to the application to them of a new method of criticism.

(1) THE FIRST KNOWN CULTURE OF THE EASTERN
MEDITERRANEAN.

11. Palæolithic Man seems to have left no traces in the Levant comparable with those in North Europe, or with the plateau and upper-gravel flints of the Nile Valley. But the scarcity of evidence is partly due to the indifference of

the natives to such objects, and to the almost complete diversion of trained research into more obvious and attractive departments; partly also to the comparative rarity, except in Egypt, both of workable flints and of the high-level gravels in which they are usually preserved. From Greece itself only one palæolithic implement is recorded hitherto; a flint celt from Megalopolis in Arkadia (*Rev. Arch.*, xv., 16 ff.).

12. Neolithic Man, however, can be traced over the whole area. Masses of hard crystalline rock are frequent and accessible, and furnished implements of characteristic types; short full-bodied celts, more or less markedly conical behind, and ground to a rather obtuse edge. Obsidian was largely exported from Melos and Thera to the neighbouring islands, and to the mainland of Greece, and was worked up at Korinth and on several sites in Attica. Jade of good quality was sent from Asia Minor outwards across the *Ægean*; but it is not yet clear whether the source of the common green variety is in Asia Minor itself or further east: the jade implements become commoner eastwards, and the finest collection from any single neighbourhood is that brought by Mr. D. G. Hogarth in 1894 from Aintab in N. Syria (Ashm. Mus., Oxford).

13. Tombs of this stage of culture have not been found—or sought—in sufficient numbers to justify discussion or to contribute any facts of importance. The necropolis of Psemmetisméno in Cyprus, for example, contains besides typical early Bronze Age tombs a still more primitive class, in which the pottery is exceedingly rude, and the characteristic red-polished ware of the early Bronze Age is wanting; but though bronze is absent, no stone implements are present. On the other hand the few tombs recorded as containing stone implements are brought down by their general character well within the Bronze Age.

14. Exception must however be made in favour of the Nile Valley, for Professor Flinders Petrie in 1895 found, at Ballas and Nagada, both tombs and villages of an invading race, apparently Libyan, which had brought the art of flint working to unequalled proficiency, and remained

almost ignorant of the copper which was already in fairly common use under the Sixth Dynasty, which immediately preceded their irruption into Egypt. But the significance of this discovery and of our very limited knowledge of the Libyan people and their civilisation will be better discussed at a later stage.

15. On the other hand, several Settlements of the Neolithic Age have been examined. Typical is the lowest town of Hissarlik, though it has actually yielded a few simple copper weapons. The implements are of local flint and imported obsidian, of green-stone and allied rocks from the interior of the Troad, and of jade; some of the common green Anatolian, others of finer yellowish kinds (*cf.* the specimen in Ashm. Mus. attributed to Melos), and one small celt of the pure white variety which is not known to exist native except in China.

16. The fortifications and house walls of the "First City" are of very rough unhewn rubble; its pottery is of local fabric, made wholly without the use of the potter's wheel, and almost uniformly tinted black by a carbonaceous pigment, intentionally applied and accentuated in the burning; many of the forms are closely allied to those of the neolithic and early bronze ages in Central Europe, and of the corresponding deposits of Greece and Cyprus. This lowest settlement is separated from the rest by a layer of natural soil, which represents an interval during which the site lay desolate; it is therefore distinctly older than the succeeding cities. But the advanced and special technique of the Pottery of the First City, and the fact that, on Schliemann's authority, copper implements already occur, indicate the end rather than the beginning of the Neolithic stage; and the Neolithic evidence from elsewhere is best summarised here, before going further in the series at Hissarlik.

17. Settlements of similar character, but each with its own local peculiarities, occur (1) on an unexcavated site, commanding the Bosphorus as Hissarlik commands the Dardanelles. (2) On the "Kastri" near Achmet-aga in Eubœa, a low hill fortified with earthworks and approached by a hollow way, like the hill camps of the south of England.

(3) Beside Dombrena near Thebes in Central Greece : the site has not been described, but neolithic implements are very frequent : among them is a potter's burnisher of white quartzite (Finlay Coll., 280. Athens). (4) On the Acropolis of Athens many implements and vases were entirely confused by the levelling of the summit in the fifth century B.C. ; on the south side (in the space afterwards known as the Πελαργικὸν) is a layer of neolithic pottery with obsidian flakes and a potter's burnisher, almost wholly destroyed by the recent excavations, and only preserved where it is left to support the fragmentary walls of the Mykenæan settlement. The material of the pottery is Ilissos mud, not the Kerameikos clay of the Kephissos valley. (5) Beyond the Ilissos, between Hymettos and the sea, the exact site is unknown, potsherds are common on the surface. The many stone heaps in this district seem to have been accumulated from off the fields on to barren spots ; two, opened south-east of Kara in 1895, were quite barren ; a tumulus north-east of Kara, surreptitiously opened, contained a Mykenæan interment (Ashm. Mus.). (6) Primitive pottery is common on the west end of the cliff which runs along the coast from New Corinth nearly to the site of Lechaion.

18. The "Second City" of Hissarlik has marked points of similarity with the first, but represents a decided advance, and has notable characteristics of its own. The walls, great and small, are of better masonry below, and of sun-dried brick above, with bonding courses and terminal uprights (*antæ*) of timber ; the centre of the fortress is occupied by a "chief's house," consisting of three oblong buildings with portico entrances at one end in a courtyard entered by a covered gateway. The pottery is still of unlevigated clay, and mostly hand-made ; it is no longer blackened as before, but either left as it is, or covered with a red slip, which continues to occur in the layers above ; new and characteristic forms appear, some peculiar, others again common to Central Europe, to the Greek islands or to Cyprus. Stone implements are still in common use, but copper and bronze begin to be frequent though they are still of simple

types. But the pre-eminent feature of the Second Town is the discovery of more than one buried "Treasure" of gold and silver jewellery and vessels, the latter certainly of local manufacture, for the forms closely correspond with characteristic types of the pottery.

19. The Second Town perished in a general conflagration, and the Third, Fourth and Fifth Towns above it never attained to anything like its magnificence. They mark, however, a gradual advance of civilisation and form a transition, more and more rapid as it proceeds, towards the Sixth Town, a quite distinct and well-marked settlement of "Mykenæan" invaders, in which imported pottery, and native imitations of this, occur alongside of fully developed indigenous forms, which again recall in characteristic details many Central European types. This Sixth Town is the only one which can be even approximately dated chronologically; it is certainly prior to 1000 B.C., and need not be later than 1300; the Fifth and lower settlements must of course necessarily be older than this.

20. It has been already hinted that the "Treasure of Priam" *may* belong to a period somewhat later than the Second Town, though not so late as the sixth or "Mykenæan" Town. Whether this be so or not, we have in the jewellery an early example, perhaps a prototype, of the characteristic gold work of the Mykenæan Age; but if the "Treasure" is contemporary with the layer in which it was found, the time limit for the whole series at Hissarlik must probably be contracted downwards. In any case we must believe that the earliest civilisation of Hissarlik was not so wholly barbarous as appears at first sight.

21. Imported objects found at Hissarlik indicate a wide range of foreign connections. The fragments of porcelain point to Egypt; the lapis lazuli axe from a neighbouring site, to Turkestan; the silver vases probably to the eastern half of Asia Minor; the types of the bronze implements alike to Cyprus and to the Danube Valley; and the amber to the shores of the Baltic. This wide commerce does not, of course, imply direct intercourse, but, from its geographical

position on the Hellespont, Hissarlik must have been a point of convergence for any trade between the East and Europe, and the catalogue of the allies of the Trojans in Iliad II., though it refers to a later period, ranges them (1) up the Hebros Valley into the Balkans, and along (2) the North and (3) the West coast of Asia Minor; *i.e.*, along three well-known routes of early trade.

22. The metallic objects of Hissarlik are of particular value as links between two principal copper-working areas, Cyprus and Central Europe. The latter really falls beyond our present view, but must be noted—mainly to be rejected—as a possible source of the early Mediterranean Bronze.

23. The use of copper in Cyprus goes back far beyond the point where it can be dated with any certainty, and everything goes to show that, while southwards, namely, in Egypt under the Fourth Dynasty, Cypriote types appear from the first side by side with others which are probably Sinaitic, northward the same types extend, past Hissarlik, into the Danube Valley, and are imitated and amplified into derivative forms throughout Central Europe; returning, almost unrecognisable, into the Mediterranean area in the series from Spain, which is clearly not directly derivative, and may be of comparatively late origin.

24. The obvious suggestion that Central Europe may have worked copper independently is met (1) by the comparison of the secondary forms,—*e.g.*, only in Cyprus can the actual synthesis of double-bladed axe heads, by welding two simple ones, be observed; (2) by the fact that, along with the characteristic and indigenous metallurgy, the ceramic technique of Cyprus, with red hand-polished surface and incised ornament filled with white earth, can be traced across Asia Minor and into South-eastern Europe; the red slip as far as Brus in Transylvania; the ornament into the Mondsee of Lower Austria, and the pile-dwellings of Switzerland, becoming ever more mongrel and degenerate as it proceeds.

25. It is important to note that at Hissarlik a return current is already evident; the pottery and the metal im-

plements reproduce European types as well as Cypriote, and this is confirmed, not only by traditional and ethnological considerations, but also by the occurrence, somewhat later, in the *Ægean* area, not only of frequent amber, but of characteristically Danubian types of bronze implements.

26. The Bronze Age civilisation of Cyprus is, thanks to repeated researches, far more continuously and completely known than any other part of the area. It was undoubtedly of very long duration, and certainly follows that of the Stone Age without change or break; and it is no exaggeration to say that, until a period between the twelfth and the eighteenth Egyptian Dynasty, Cyprus was in all essential respects in advance, not only of the coasts of Asia Minor and the *Ægean*, but even of the coast of Syria and Palestine.

27. All the earliest weapons, whether in Cyprus or elsewhere, in Egypt, or the Levant, are of almost pure copper. Tempering is effected, not by alloying with zinc or tin, or, as in the Caucasus, with antimony from the natural double-sulphide ore, but by "under-poling" the copper so as to leave it hard and even brittle from the presence of copper oxide. The same applies to the Egyptian copper weapons of the fourth, fifth, and even sixth Dynasty; but Egypt, though later on it has important connections with Cyprus, obtained its first copper from the mines of Sinai, and has a set of typical forms peculiar to itself. Cyprus, however, supplied the Syrian coast with copper weapons down at all events to the time of the eighteenth Dynasty. Stone implements are very rarely found in Cyprus, and it is possible that either the island was not reached much before the beginning of the Bronze Age, or that its wealth of copper was discovered at once, and superseded the stone age prematurely. In its earlier stages metallic implements are rare, and the pottery—always made by hand—is covered with a bright red glaze which was polished with a stone or bone rubber (horse teeth were commonly used), and ornamented, if at all, either by incised lines or by pellets of clay rudely modelled after plants, snakes and

horned animals. In its earlier part, therefore, the civilisation, so far as it is known, is peculiarly uniform in character, and displays no trace of foreign influence; except only that the characteristic red-polished glaze of the pottery, already mentioned, is almost identical with that of the Neolithic Libyan people of Ballas-Nagada, and of their "Amorite" kinsfolk in South Palestine. Even here, however, there is no evidence at present of imitation on either side. The strong influence which Cyprus exercised, through its copper trade, over the neighbouring coastland is best illustrated by the discoveries of Dr. Bliss at Tell-el-Hesi, on the coast plain of Palestine (Philistia), some sixteen miles from Gaza. The site consists of an acropolis with eight "Cities" superimposed as at Hissarlik. The mass of the remains represent an indigenous "Amorite" civilisation of low type, related, according to Professor Flinders Petrie, to that of the Libyan invaders of Ballas-Nagada. But bronze appears from the bottom of the series upwards, and iron already in City Four, which with City Three appears to be contemporary with the eighteenth Dynasty and the Mykenæan Age. The bronze types are derivative, partly from Cyprus, partly from Egypt; and Cypriote importations of the later painted fabrics occur in Cities Two and Three together with native imitations. The red-polished pot fabric of Tell-el-Hesi, however, belongs to the Amorite civilisation, and is not necessarily borrowed from that of Cyprus.

28. In the latter half of the Bronze Age, Cyprus with characteristic conservatism fell for a while slightly behind its neighbours, and began to import ornaments and articles of luxury from Egypt and the Syrian and Cilician coasts. In this stage the red-polished ware tends to deteriorate in colour and finish; the bronze weapons become more numerous, and contain a higher percentage of tin, and occasionally jewellery of coarse silver-lead, all of native make, is found in the more richly furnished tombs. Babylonian cylinders occur rarely as imports, with a multitude of characteristic native cylinders. Egyptian scarabs and porcelain beads are also found rarely; and with these again a very common variety of coarse crumbly porcelain badly glazed

with a very faint blue : the pigment was evidently difficult to obtain, and was used but sparingly by the native artist. But meanwhile the discovery of the art of ornamenting the natural surface of clay vessels with an encaustic umber pigment, wherever it may have originated, seems to appear in Cyprus (where umber is extensively worked) at least as early as anywhere else ; first in company with, but later almost wholly superseding, the older mode of incising linear ornaments on a prepared and polished surface.

29. The simply painted pottery is followed, though not immediately, by several other fabrics which, though probably native to Cyprus, are represented in some quantity on Egyptian sites of the twelfth Dynasty and later dates, and also in equivalent layers in the stratified mound of Tell-el-Hesi, in the "Hittite" Sinjirli, and sporadically elsewhere ; one very characteristic variety, with dark body, white chalky slip, and black almost glossy paint, has been found even so far afield as the Island of Thera, the Acropolis of Athens, and the "Sixth City" of Hissarlik.

30. The specimen from Thera was found in company with vases of a distinct and local style ; some still with coloured surface and incised ornament, others with simple painted patterns. The forms, however, and the whole fabric, are quite distinct from those of Cyprus, and show a graceful freedom which is quite new ; though they are clearly derivative from a ceramic of the Hissarlik type. Most important of all, the wholly geometrical and mainly linear ornament which has been hitherto universal is combined with or replaced by a thoroughly and vigorously naturalistic study of animal and vegetable forms, and, in combination with the latter, spiral motives appear, hitherto unknown but destined to a long and eventful career. These naturalistic and curvilinear designs are not only represented on the pottery, but are also frescoed upon the plastered walls of the houses ; they may consequently be taken to be locally characteristic. The settlement at Thera was found beneath a thick bed of volcanic debris, and had evidently been suddenly abandoned ; metallic objects are rare, but this may well be due, as M. Tsountas suggests, to the flight of the inhabitants—for no

skeletons were found ; and a few copper implements and gold ornaments remained to confirm the inference from the pottery as to its position in the series.

31. Settlements and tombs of the same character have since been noted in many islands of the Archipelago, especially in Syros, Melos, Antiparos and Amorgos ; and this "Cycladic" type of ornament and general civilisation is not only closely paralleled by the earliest remains at Mykenæ, Tiryns, Athens and elsewhere, but is connected by an almost continuous series with the fully developed art and civilisation of the Mykenæan Age itself.

32. It should be noted that though Cyprus appears to have exported its own manufactures to the Ægean during this period, it was not in a position to influence or direct the Cycladic culture. But still less is there any trace that the younger and more vivacious school reacted at all upon the elder ; this was reserved for the full-grown culture of Mykenæ.

33. It is at this period that the Cretan evidence, though as yet miserably incomplete, becomes of crucial importance. Crete shares, to begin with, the early bronze age civilisation of Hissarlik and Cyprus, resembling the latter more closely ; but it is not till the Cycladic stage is reached that we have more than the most fragmentary evidence. In the Cycladic period and in the succeeding age Crete was almost literally *ἐκατόμπολις*, the "island of an hundred cities," and certainly exercised a vigorous and continuous, perhaps even a predominant influence upon Ægean civilisation. At this point the wealth and variety of Cretan decorative art become conspicuous, and a chronological point of the very first importance and a clue to the origin of some characteristic motives are given by the recent demonstration of a frequent and fertile intercourse with Egypt in the time of the twelfth Dynasty. On the one hand, a very peculiar and local fabric of pottery from Kamárais in Crete has been found in twelfth Dynasty layers at Kahun ; on the other, the Cretan types of bronze implements are typically Egyptian, and twelfth Dynasty scarabs were not only frequently imported, but commonly imitated. In fact it is very probably from this

quarter that the spiral motives, which are dominant in the Egyptian Art of the twelfth Dynasty, were introduced into the decorative repertory of Ægean art.

34. The seal-stones engraved with Egyptian and derivative spirals are closely associated in Crete with others bearing groups of symbols, more than eighty of which have been recorded, and shown to be hieroglyphic, by Mr. A. J. Evans. They exist in two series, of which the earlier is fully pictorial and naturalistic, the later conventionally abbreviated into linear forms. Some of the former are closely analogous to certain Egyptian, others to certain "Hittite" hieroglyphs from Kappadokian monuments; many of the latter are identical with *graffiti* on twelfth-eighteenth Dynasty pottery from Kahun, Tell-el-Hesi and elsewhere, and some are probably prototypes of symbols which persisted in the Phœnician, Greek and Lykian alphabets, and in the Cypriote syllabary. This hieroglyphic system is not confined to Crete, though it is far best represented there as yet; the pictorial seal-stones are distributed over the Cycladic area; and two inscriptions in the linear character have been found on vases at Mykenæ. Dr. Kluge, of Magdeburg, believes that he can translate these hieroglyphic inscriptions into a dialect of Greek.

35. We now come to what is, even literally, the Golden Age of the early Mediterranean cycle. "Mykenæan" Art is still best and most completely illustrated by the long series of discoveries in the plain of Argos, which at once revealed its existence, and have given to it a name. The monuments and the civilisation of Mykenæ and Tiryns have been repeatedly, though never yet really adequately, described, and have given rise to the most divergent theories as to their date, their origin, and their relations with what precedes and follows them. The following points are those which are chiefly made clear by the most recent researches.

36. The limits within which Mykenæan sites are distributed may now be defined with some approach to accuracy, and no less the wider area over which Mykenæan civilisation had a living influence. With the exception of

the "Sixth City" of Hissarlik no Mykenæan settlement is known on the mainland of Asia Minor. Isolated vases are reported from Pitane in Æolis, from Mylasa in Karia, and from Telmessos in Lykia, and the early necropolis of Termera (Assarlik) near Halikarnassos (Budrum), though of distinctly indigenous character, is strongly influenced, at the very end of the period, by late Mykenæan models from the neighbouring islands. Among the latter, besides the great settlement at Ialysos in Rhodes, every island appears to be represented from Rhodes southwards to Crete, and northwards as far as Patmos. Both in Melos and in Thera Mykenæan settlements are found distinctly superimposed on the Cycladic already mentioned, and others are indicated by isolated finds throughout the Archipelago. On the mainland of Greece, Lakonia is represented by two sites Kampos and Vaphio (Amyhlæ), the latter with a princely "beehive tomb" like those of Mykenæ; Argolis by Mykenæ, the Heraion temple-site, Tiryns, Nauplia, Trœzen, Epidauros, and the islands Kalauria and Ægina; Attica by Athens, Eleusis, Acharnæ (Menidi), Aliko, Kara, Spata, and Thorikos; the rest of Central Greece by Megara, Antikyra, Thebes, Tanagra, Levidia, Orchomenos and several smaller sites in the Kopais marshes; North Greece by Pagasæ (Dimini near Volo) in Thessaly.

37. In the West there are no Mykenæan settlements known further than Kephallenia and Ithaka; but Mykenæan vases occur in domed rock tombs at Syracuse, and there is much indirect evidence of Mykenæan influence on the later Bronze Age style in Sicily and South Italy. Further than this, it is clear that on the Adriatic coast of Italy Mykenæan imports and models determined the character of the later Bronze Age, and that in the transition from Bronze to Iron at Hallstatt in the Tyrol, a definitely Mykenæan strain can be detected. But in both these cases the contact is with later and already quite decadent types, such as are represented in the Lower Town of Mykenæ; in particular fibulæ are always present, and of these the secondary and distinctly Sub-Mykenæan types are only very rarely absent.

38. Eastwards, Mykenæan imports are found frequently

in Cyprus, in the latest class of Bronze Age tombs, and give a very distinct character to the necropoleis of Episkopi (Kurion), Enkomi (Salamis), Pyla, Nikolidhes, and Laksha-tu-Riu. Native imitations increase in frequency, and eventually supersede the importations and fix the leading features of the art of the early Iron Age, *e.g.*, at Kuklia (Paphos), Lapathos and Katydata-Linu. In Egypt again, Mykenæan importations are found in great quantity, associated with the later Cypriote fabrics and stimulating copious native imitation in layers of the eighteenth Dynasty at Illahun, Gurob, Tell-el-Amarna. These last finds confirm the date already inferred from the occurrence of eighteenth Dynasty scarabs and porcelain ornaments at Ialysos and at Mykenæ, and fix the general chronology of the Mykenæan Age beyond all question. The contrary opinion, that the Mykenæan civilisation immediately precedes the Orientalising culture of the seventh-sixth centuries, and consequently itself descends as late as the eighth-seventh centuries, has been vigorously urged by a few English students, but has long been abandoned by all who have had first-hand experience of the conditions of discovery. The premature contention that the fortress of Tiryns was Byzantine deserves mention, but is obsolete.

39. It is in Egypt also, moreover, that the first notice occurs of the actual peoples who transmitted the civilisation in question, and this in a peculiarly suggestive connection. In the fifth year of Merenptah (1225) and under Rameses III. (1180-1150) the western frontier of Egypt was seriously threatened by a Mediterranean coalition, of which the Libyans were the principal members, but which included under the general description of "the peoples of the isles of the sea" a number of tribes whose names, though much distorted in the Egyptian hieroglyphic records, strongly resemble those of Achaians, Danaans, Ionians, Teucrians, Tuscans or Tyrrhenians, and perhaps Sicilians and Sardinians. Neither these names, of course, nor yet the apparent resemblance of their arms and furniture, as depicted in Egyptian paintings, can give more than a plausible presumption of identity either with historical Ægean races or

with the representatives of Mykenæan civilisation. But the analogies are on all sides so close, that the identification is usually accepted, and that as soon as even the outlines of the history and civilisation of Libya during the Bronze Age are ascertained, we shall be in a position to formulate the real relations which then existed between Libya and the Ægean, and probably also to trace more clearly to its source the very remarkable realistic instinct which distinguishes the art of the Ægean from all contemporary styles.

40. The sudden collapse of the Mykenæan civilisation, which was indicated to begin with, is roughly coincident with the first appearance of Iron in common use in the Levant, and the attempt has been made, though on no direct evidence, to connect the two tendencies. All the facts go to indicate that, so far as the Mediterranean area is concerned at all events, iron makes its appearance first on the Syrian coast, in the period which immediately succeeds the downfall of Egyptian suzerainty in that area under the nineteenth and twentieth Dynasties: *e.g.*, at Tell-el-Hesy iron occurs down to the fourth "City" (= eighteenth Dynasty). The ambiguity of the Egyptian allusions under the eighteenth and previous Dynasties makes any earlier date uncertain, and iron has not been actually *found* in Egypt before the twenty-sixth Dynasty, 650 B.C. In Cyprus, where the evidence is completest, and where abundant native ores have certainly been worked from an early period, iron suddenly becomes very common just at the point when Mykenæan vases are ceasing to be imported, but when, on the other hand, Mykenæan conventions have already begun to influence profoundly the native scheme of ornament. At Mykenæ itself iron occurs first as a "precious metal" and in the form of signet rings, at the stage where decadence begins to be rapid, but it is not put to practical uses till the moment where the series breaks off, and the same is the case in other Mykenæan sites in the Ægean; one iron sword was found in the Vaphio "beehive".

41. Up the Adriatic again it is with the early fibulæ and quite degenerate Mykenæan art, that iron makes its appear-

ance, at Novilara ; and at Hallstadt ; and here again, both in tradition and among the finds, there is evidence that the metal became established first as an ornamental rarity, and only subsequently as a substitute for bronze.

42. But though in its principal centres Mykenæan civilisation has all the appearance of having been suddenly and violently extinguished, this must not be taken to be universally the case. In Argolis (at Tiryns, and the Heraion), in Attica, and in Melos, for example, there is every reason to believe that the Mykenæan civilisation survives, though in very degenerate phases, into the period when Iron and the characteristic art of the early Iron Age are already well established ; and at Nauplia and the Attic Salamis, and still more in Crete, in Karia, and in Cyprus, the stages may be clearly traced by which, so far as in it lay, the Iron Age took up its inheritance from the Age of Bronze. The nature and the result of this transference are easily summarised.

43. It has been already indicated, firstly, that throughout the Eastern Mediterranean, in fact throughout the whole range of the Mediterranean Early Bronze Culture, the indigenous system of decoration is instinctively rectilinear and geometrical ; secondly, that in the Cycladic area and in the Middle Bronze Age a quite irreconcilable and purely naturalistic and quite heterogeneous impulse appears ; and thirdly, that the fully formed Mykenæan style, when it appears, is, in spite of its far superior technical skill and elegance, already beginning to stagnate in many departments ; the gem-engraving and modelling developing last, and retaining their vigour and elasticity latest ; whereas the ceramic decoration, which appears in its noblest form at Thera and at Kamárais, is the first to exhibit the conventional and mechanical repetition of a shrinking assortment of motives. We may now add, fourthly, that this failure of originality permitted of a recrudescence of the rectilinear instinct which, though overwhelmed for the time by the naturalistic and curvilinear principles, had co-existed with them throughout ; and that both floral and spiral motives, once allowed to repeat themselves without

reference to their models, are transformed automatically into the latticed triangles and mæanders, which are the commonplaces of rectilinear design.

44. At this point the survey must close, for now, on geometrically engraved tripods, and geometrically painted vases, appear Hellenic inscriptions in alphabetic characters. Borrowed Oriental, and especially Assyrianising, motives intrude themselves into the panels of the rectilinear ornament, and attempts are made, however ineffectual, to represent first animal and then human forms. Now, in the development upward out of the "Dark Age," Hellenic history begins to reckon onward from the Trojan Era and from Olympic and kindred lists; and Hellenic art no longer forward from the eighteenth, but backward from the twenty-sixth Dynasty.

LEVANTINE ETHNOLOGY, AND SUMMARY (*to follow*).

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THE GRAPTOLITES.

THERE is, perhaps, no better illustration in geology of the value of detailed work than that which is furnished by the group of organisms, to the consideration of which this article is devoted. Formerly viewed with suspicion by biologist and geologist alike, and frequently altogether ignored, we find the graptolites now treated with respect even by those who have not devoted special attention to them. Their value is generally recognised as aids in the determination of the age of strata, but besides this, a detailed study of the group will undoubtedly throw light upon the physical and climatic conditions under which the strata containing graptolite remains were deposited, and also upon the evolution of the various forms of graptolites. Every one will admit that the appreciation in which graptolites are now held is largely due to three papers by Professor Lapworth, one of which treats of these organisms from a biological (1), and the second (2) and third (3) from a stratigraphical point of view; and the publication of these papers is doubtless largely responsible for the appearance of a large number of memoirs devoted to a study of the group under consideration which have been written of recent years. These recent memoirs it is the object of this paper to consider.

The memoirs, early and more recent, treating of the graptolites are scattered through a variety of publications, but an excellent bibliography compiled by Otto Herrmann and published in his *Inaugural Dissertation* (4) gives a list of these memoirs up to and including the year 1883. Even with this guide the student has much difficulty in obtaining access to some of the publications, and a general monograph of the graptolites has yet to be written. In the list of "Monographs which are promised or are in course of publication" appended to the last "Monograph of the Palæontographical Society" we note "The Graptolites," by Professor Lapworth, and all geologists must hope that ere

long the professor will give to the world the full results of his prolonged researches into the history of the group. This monograph must necessarily be confined to an account of the British graptolites, but when that is complete surely Professor Lapworth will treat of those of other countries also.

The graptolites, at one time referred by some writers to the Hydrozoa, by others to the Polyzoa, are now generally admitted to belong to the former class, though the exact value of the sub-division is not definitely settled, for whereas we find Professor von Zittel in his *Palæontology* treating of them as a sub-order, Graptolithidæ (= Rhabdophora, Allman), divided into the groups Graptolitoidea Lapw. and Retioloidea Lapw., Nicholson and Lydekker (*Manual of Palæontology*) place them in a sub-class (Graptolitoidea). In these works the general structure of the graptolites is described, though, as will be seen in the sequel, one structure supposed to be absolutely characteristic of all graptolites, namely the virgula, is not really so. Comparatively little has been added to the knowledge of the histology of the graptolitoidea furnished by H. Richter (5), though some of his results have been confirmed by Professor Sollas (6); and additional information has been supplied by Professor S. L. Törnquist (7) and Dr. Perner (8). Some of the most important papers published of recent years treat especially of the mode of growth of the proximal portions of the graptolites. The first of these by Törnquist (9) is occupied with a description of sections through several deprionidian graptolites. The author distinguishes the obverse from the reverse aspect of the polypary, and also introduces two terms to distinguish its right and left portions—the "primordial" portion, containing the "primordial" series of hydrothecæ, is marked by the possession of the earliest hydrotheca, whilst the other portion is termed the "second" portion and possesses the second series of hydrothecæ. When the obverse aspect of the polypary is turned towards the observer the primordial series of hydrothecæ is invariably on the left hand. The sícula sends out what the author terms a "connecting canal" which opens into a

"biserial chamber," thus producing a connection between the various parts of the polypary. These features are common to all the forms described by the author, but the forms differ in other respects. In *Climacograptus scalaris* Linn. and *Climacograptus internexus* Törnq. the biserial chamber communicates with two uniserial canals separated from one another by a median septum. In *Diptograptus palmensis* Barr. the septum scarcely extends through half the thickness of the polypary, whilst in *Cephalograptus cometa* Gein. it is "reduced to a narrow fold of the obverse periderm," and in *Diptograptus bellulus* Törnq. it is altogether absent.

Two papers by Wiman (10) treat of the structure of the *Diptograptidae* and of *Monograptus*. Notices of these papers by E. M. R. Wood and G. L. Elles appear in the *Geological Magazine* for 1895, p. 431. The accounts of the structure of the sicula, and of those parts of the polypary immediately in contact with it, are largely confirmed by Holm in a paper to be noticed immediately, but the statement that the *Diptograptidae* are monoprionidian because the sicula gives rise to only one bud (which is on the right hand side) involves a special use of the term monoprionidian which will hardly meet with general acceptance.

A most important paper by Gerhard Holm must now be noticed (11). Holm has had the advantage of studying some beautiful material derived from the *Vaginatus*-limestone (of Areing age) from various localities in the northern part of the Island of Öland; the graptolites of this limestone he has succeeded in freeing from the matrix, thus rendering them serviceable for detailed study. (The method of removing the matrix is described by Holm in an article in *Bihang K. Vetensk. Akad. Handl.*, Bd. xvi., 1890.) In the present paper he gives reasons for supposing "that the earlier development of the proximal part—the first three thecae—in all the bilateral or diprionidian forms of graptolites is in the main the same, and has taken place through the formation of only one bud on one side of the sicula—or first theca, as I believe it is—which side is always the same in relation to the later development of the polypary. From

this bud thereafter is developed partly the second theca, partly the canal—'connecting canal'—which connects both halves of the polypary, and which in the first place gives origin to the third theca (= first theca on opposite side of sicula), and partly also the common canal which connects the second theca with the succeeding ones." He describes the "sicula" which consists of two distinct portions, the "initial part" which he believes to correspond with the original "chitinous covering of the free zooid germ or embryo," and the apertural part which has the same function as a theca and may therefore be justly considered as the first theca. Accordingly Holm's second theca corresponds to Törnquist's primordial one, and his third to Törnquist's second.

The sicula in the bilateral graptolites does not occupy a central position, being partly embraced on one side by the connecting canal, whilst on the other side it is more or less superficial. The sicula side is termed the "anterior," and the other the "posterior". These are used in the same sense as that in which Törnquist employs the terms "obverse aspect" and "reverse aspect". The author gives a full account of the connection between the sicula, the first theca, the first bud, from which "arises almost simultaneously with the left theca the common canal for the left half of the polypary, and the connecting canal which crosses the dorsal side of the sicula and gives origin to the third (or, better, the right) theca lying on the right side of the polypary, and also the common canal for the right side of the polypary," and describes the growth of these in *Didymograptus minutus* Törnq., *D. gracilis* Törnq. mut., *D. gibberulus* Nich., *Tetrgraptus Bigsbyi* Hall, and *Phyllograptus angustifolius* Hall.

He maintains that a virgula cannot occur in any graptolites of the families *Dichograptidae*, *Dictyograptidae*, and *Nemagraptidae*, or in the genus *Dicellograptus* of the family *Dicranograptidae*. The true virgula commences near the apex of the sicula as a prolongation of the same, and corresponds with the thread-like prolongation of the sicula which has long been known in *Didymograptus*

gibberulus, and certainly occurs in many other forms of *Dichograptidæ*. Another filiform appendage which might be spoken of as the false virgula "originates as a result of growth within the apertural end of the sicula at some distance from the initial portion. This later structure stands evidently in no relation whatever to the real virgula, but may be regarded as an apertural spine." The significance of these filiform processes has not yet been fully explained, but the possession of a true virgula must in future be omitted from diagnoses of the characters of the subclass or sub-order of the graptolites. Holm's researches fully confirm Tullberg's inference that *Phyllograptus* belongs to the family *Dichograptidæ*, and the family *Phyllograptidæ* must now be abandoned. Another interesting point bearing upon classification is the position from which the bud grows out of the sicula. "In *Phyllograptus* it is situated quite close to the apex of the sicula, in *Tetragraptus Bigsbyi* Hall probably slightly lower down, in *Didymograptus minutus* Törnq. somewhat below the middle of the sicula, in *Didymograptus gracilis* Törnq. Mut. still nearer the aperture; but in *Didymograptus gibberulus* Nich. the position is almost the same as in *Phyllograptus*." The reference of the genus *Azygograptus* to the *Nemagraptidæ* on account of the stipe being developed from the central part of the sicula on one side is therefore unnecessary, and the general characters of *Azygograptus* leave no doubt that it belongs to the *Dichograptidæ*; indeed Holm in the paper under consideration describes a form which is possibly intermediate between *Didymograptus* and *Azygograptus*.

The association of a number of graptolites of the same species in a fairly symmetrical manner has long been known. James Hall in plate xiv. of his classic work on graptolites (12) figures a diprionidian graptolite under the name of *Retiograptus tentaculatus*, and in figure 9 is "an illustration of a compound form of the genus," possessing nearly twenty diprionidian stipes diverging from a common centre. James Dairon (13) also figures specimens of *Monograptus* occurring in partly symmetrical tufts, and remarks: "I am now thoroughly convinced that many, if

not all, of the specimens of *Monograptus* may have been fixed to the sea-bottom, or to objects lying or growing on it, and not have been free-floating organisms, as has hitherto been supposed, until at last they were separated from their points of attachment by breakage or some other natural cause". Recently a remarkable description has appeared (14) giving an account of specimens of *Diptograptus pristis* Hall and *D. pristiniiformis* Hall from the Utica Slates. In these specimens the stipes occur in "compound colonial stocks which appear in the fossil state in stellate groups". From observations on the specimens, the author infers "that the colonial stock was carried by a large air-bladder, to the underside of which was attached the funicle. The latter was enclosed in the central disc, and this was surrounded by a verticil of vesicles, the gonangia, which produced the siculae. Below the verticil of gonangia and suspended from the funicle was the tuft of stipes," the latter being so arranged that the "sicala-bearing end of the single stipes appears in the compound colonial stock as the distal one". The paper is only an abstract of one which is promised shortly, and geologists will await with interest a full account of these remarkable specimens. The structure described as a funicle can hardly be looked upon as the analogue of the "organ" described by Hall under that name (which by the way has been proved by Brögger and Holm to be celluliferous in many species, so that Holm is doubtless correct when he says that a funicle has not been found in any graptolite). It is remarkable that the author should explain what he means by the assertion that the chitinous capsule which encloses the "funicle" on the specimens described is identical with the "central disc" of the compound fronds of numerous *Monograptidae*, for no geologist, as far as I am aware, has described *Monograptidae* with compound fronds, unless Dairon's specimens be taken as such.

The early writers on graptolites looked upon the number of stipes possessed by graptolites as a character of prime importance in defining genera, such forms as *Dichograptus*, *Tetragraptus*, *Didymograptus* and *Monograptus*

being largely characterised by the possession of eight, four, two stipes and one stipe respectively. In a recent paper by Professor Nicholson and the present writer (15) we have endeavoured to show that this is not the case, but that the character of the hydrothecæ and to a less degree the amount of angle of divergence of the stipes are of importance. We endeavour to prove that certain graptolites underwent development along parallel lines, passing through many-branched, eight-branched, four-branched, two-branched and one-branched forms, thus illustrating the principle of heterogenetic homœomorphy advocated by Mojsisovics, S. S. Buckman and others. If this be allowed, many of the present genera will have to be abolished and new ones formed; but the writers earnestly advocate the retention of the present genera under existing circumstances, and hope that the formation of fresh genera will be deferred until our views are more fully developed or perchance disproved, though we do not think that the latter event is likely.

It will be noticed that the above researches into the morphology of the graptolites deal mainly with the celluliferous portions of the polyparies, whilst the study of the various bodies referred to as concerned in reproduction has not been largely pursued of recent years.

Passing now to the memoirs treating of the graptolites as indices of age of the rocks which contain them, it may be remarked at the outset that recent work has fully established the correctness of the views advanced by Lapworth in his papers on the Moffat series and on the geological distribution of the *Rhabdophora*. Perner alone has stood out for the anomalous occurrences described by the eminent Barrande in the Bohemian basin, but he does not yet appear to have studied completely the zonal distribution of these organisms in that region, though he has added largely to the number of species occurring in the Lower Palæozoic rocks of Bohemia. The new species described here and elsewhere of recent years it is not contemplated to notice in this article, though they will doubtless give us much information in addition to that we have already obtained

concerning the morphology and phylogeny of the graptolitoidea. It would serve no useful purpose to give details of the numerous papers which confirm the value of the graptolites for purposes of correlation of the strata. In Britain, Lapworth himself has described a number of graptolitic bands interstratified with deposits containing the remains of other organisms in Ayrshire (16). Much remains to be done in this respect, for in order to utilise to the utmost the value of these organisms as stratigraphical indices, it will be necessary to have a complete correlation of graptolitiferous strata of all ages, with those which contain these organisms rarely or not at all. For this purpose all graptolites should be carefully collected and preserved from out of those deposits in which they are not frequent, and are associated with other organisms. They should be looked for especially in calcareous deposits, for as we have already seen, such specimens are particularly valuable as furnishing information concerning the morphology of these fossils. The southern uplands of Scotland have recently been re-examined by the geological surveyors, and it is scarcely necessary to state that they have fully confirmed Professor Lapworth's classification of the Lower Palæozoic Rocks of this region. In England Professor Nicholson and the present writer have defined graptolitic zones in the Skiddaw Slates, Llandovery, Tarannon, Wenlock and Lower Ludlow Beds (17). Messrs. Lake and Groom have detected the *Monograptus gregarius* zone of the Birkhill shales and zones of *Monograptus personatus*, *M. Flemingii*, *M. colonius* and *M. leintwardinensis* near Corwen and Llangollen (18), whilst in a paper which has hitherto only appeared in abstract, Miss Wood and Miss Elles have detected several zones of the Birkhill-Gala beds near Conway. On the Welsh borderland W. W. Watts has found one graptolitic zone of Wenlock and two of Lower Ludlow age on the Long Mountain (19). In addition to this, various other graptolitic zones have been detected in different parts of Great Britain, and the zones of the Moffat area have been traced into Ireland. On the European continent, Linnarsson, Brögger, Törnquist, Tullberg and others have detected numerous graptolite

zones in Scandinavia, a full account of which appears in Tullberg's paper on the graptolites of Scania (20), one of the most valuable of recent contributions to the literature of the graptolites. Törnquist, Perner, Barrois and others have also identified various graptolitic zones in Thuringia, Bohemia and France. In North America the principal contribution is by our own countryman, Lapworth, who has identified a number of graptolite zones in Canada, which are identical with those detected in Europe (21). In Australia T. S. Hall is studying the well-known Areing graptolite fauna, and finds that the graptolites here also are limited to special zones (22). A number of other papers might be quoted to show the general recognition of the utility of graptolites for purposes of correlation of strata, but enough has been said to indicate the manner in which the work is progressing, and the vast amount which yet remains to be done in this connection. I cannot leave this part of the subject without uttering a warning note. More harm is done by a wrong determination than good by a correct one. The graptolites are by no means easy of identification by those who have not made them a special study, and it is particularly desirable that no determination should be recorded by tyros, unless it is absolutely certain, for when once a wrong name has crept into a list it is exceedingly difficult to remove it. I could give several instances of very serious mistakes of this kind which have been made, each of which will have to be corrected elsewhere, but it would be invidious to give names in a general article of this character.

We may now pass on to consider the physical conditions under which the graptolite-bearing strata were deposited. There is very little doubt that they were formed in water of very different degrees of depth, for graptolites are found in arenaceous, argillaceous and calcareous strata. They have mainly been collected from deposits which there is every reason to suppose were formed in deep seas, because a much greater number of individuals occur in a given space under such conditions than when the deposits were formed rapidly. The writer has elsewhere given cases of graptolitic deposits

a few feet in thickness, being represented by thousands of feet in adjoining regions, and one naturally discovers forms more easily in a few feet of strata than in several thousand feet where the process of search rather closely approximates to that for the proverbial needle in the haystack. The evidence which is being gathered shows more strongly than ever that the thin graptolite-bearing shales, which for the above reasons have come to be looked upon as the deposits for graptolites *par excellence*, were deposited slowly in waters some distance from continents, and probably of considerable depth. The evidence for depth depends mainly on the nature of the associated organisms, which are frequently dwarfed, and either blind or with enormously developed eyes, whilst that for deposition at a distance from land is confirmed by the ever-increasing number of cases of association of graptolitic deposits with others which are composed almost exclusively of tests of radiolaria. The most striking case of this has recently been detected by the geological surveyors amongst the rocks of the Southern uplands of Scotland (23). Messrs. Peach and Horne have there discovered beds with *Tetragraptus* of Middle Areing Age, separated from beds with characteristic Glenkiln (Upper Llandeilo) graptolites by a thin deposit of radiolarian chert. "We thus perceive that the great mass of strata which elsewhere forms the Upper Areing, and the Lower and Middle Llandeilo formations are here reduced to not more than sixty or seventy feet. Judged by the palæontological evidence these thin cherts appear to be a chronological equivalent of thousands of feet of ordinary sediment in North Wales. They, no doubt, were deposited with extreme slowness in a sea of some depth, and over a part of the sea-floor which lay practically outside the area of the transport and deposit of the terrestrial sediment of the time."

The graptolites are generally viewed as type-fossils of the Lower Palæozoic rocks, and this view is practically correct. The earliest graptolite which has hitherto been described, *Dichograptus? tenellus* Linnrs., occurs in the Lingula Flags of Sweden, below the shales with *Dictyo-*

graptus flabelliformis Eichw. which are so widely distributed. This *Dictyograptus*, by the way, which has a very limited vertical distribution, is probably in no way related to the long-ranged *Dictyonema*. Graptolites are extremely rare in the Upper Ludlow rocks, and have been detected in the Lower Devonian rocks of Bohemia, though it is doubtful whether their asserted occurrences in rocks of Devonian age in Scotland and the Harz Mountains are correct. It may be taken as fairly certain that they finally died out in Devonian times. Between the earliest and latest graptolitic deposits we have already a large number of graptolitic zones, which it will be of use to print in one connected list as this has not been heretofore done. So far as they have been made out they are, in ascending order, as follows: *Lingula Flags*; (i.) Zone of *Dichograptus? tenellus*, Zone of *Dictyograptus flabelliformis*. *Tremadoc Slates*; Zones of *Bryograptus*. *Areing Beds*; Zones of (i.) *Dichograptus*, (ii.) *Tetragraptus*, (iii.) *Didymograptus indentus var nanus*. *Llandeilo Beds*; (i.) Zone of *Didymograptus Murchisoni*, (ii.) Zone of *Cænograptus gracilis*. *Bala Beds*; Zones of (i.) *Climacograptus Wilsoni*, (ii.) *Dicranograptus Clingani*, (iii.) *Pleurograptus linearis*, (iv.) *Dicellograptus complanatus*, (v.) *Dicellograptus anceps*. *Llandovery Beds*; Zones of (i.) *Diplograptus acuminatus*, (ii.) *Diplograptus vesiculosus*, (iii.) *Monograptus argenteus*, (iv.) *Monograptus convolutus*, (v.) *Cephalograptus cometa*, (vi.) *Monograptus spinigerus*, (vii.) *Rastrites maximus*. *Tarannon Beds*; Zones of (i.) *Monograptus turriculatus*, (ii.) *Monograptus exiguus*, (iii.) *Cyrtograptus Grayæ*. *Wenlock Beds*; Zones of various species of *Cyrtograptus* not yet fully worked out. *Lower Ludlow Beds*; Zones of (i.) *Monograptus bohemicus*, (ii.) *Monograptus Nilssoni*, (iii.) *Monograptus leintwardinensis*. *Upper Ludlow and Lower Devonian*; Zones of undescribed graptolites.

It is quite certain that this number will be very largely increased as a result of further work, but it is sufficient to show the importance of the Lower Palæozoic rocks when it is remembered that many of these Zones contain a fauna largely distinct from the faunas of the adjoining ones.

When the Zones are worked out more fully than is the case at present, we shall have a far better gauge of "Geological Time" than that founded upon the crude estimates made by measuring thicknesses of strata.

Lastly, the study of graptolites may possibly throw some light upon climatic change. I have already enlarged upon this elsewhere (24), and pointed out that the separation of graptolitic deposits from non-graptolitic ones amongst the Stockdale shales of the Lake District, the deposits themselves being lithologically similar, is most readily explicable by climatic change. The argument would be stronger had microscopic examination and chemical analyses of the strata been made, and I should be glad to supply any one who cares to look into this question, which is one of some interest, with material for such examinations.

In conclusion, the above notes will be sufficient to show the importance which the graptolitoidea have assumed not only to the geologist but also to the biologist. That they differ in any remarkable respect, as regards their teachings, from any other group of fossils is doubtful. Their special utility lies in the fact that owing to their characters they are preserved in sufficient numbers to allow collectors to obtain a large suite of specimens of almost every species with little difficulty; the result is that further advance has been made in their study than in that of many other groups which like them are only preserved in the fossil state. One word to the biologists. We are often told that fossils are of little use on account of the absence of soft parts, though biologists have not been much hampered by this when dealing with the Vertebrata. But to compensate for the want of soft parts, we are furnished with a countless supply of specimens whose order of appearance and disappearance we are able to a large extent to ascertain, and this is what the biologist can never obtain by confining his attention to recent organisms. From them he has been able to ascertain that evolution occurs; how it occurs is left for the palæontologist to describe. That the study of these organisms as pursued up to the present has not

been in vain, is conclusively proved by the best of all tests, namely, that we are able to predict the discovery of forms which are afterwards detected by the worker in the field, to whom we commend this group as one specially worthy of his attention.

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INSULAR FLORAS.

PART VI. (B).

IN my article (59) on the flora of the African Islands of the Indian Ocean, I dealt with the subject in considerable detail, but beyond the vascular cryptogams I had very few data concerning the Isle of Bourbon. Since then Dr. Cordemoy has published a *Flora* of the island (60), which is a consolidation of all the materials he has been able to collect during the leisure of upwards of thirty years' residence in the island, though unfortunately without a full collation with the rich earlier collections in the Paris Herbarium of Commerson, Du Petit-Thouars, and other botanists. Moreover, he has not worked out the geography of the plants to the extent he might have done, so that it takes some time to find and extract the particulars of special interest to the geographer. Indigenous and naturalised plants are included in the same enumeration without any typographical distinctions; and the summary is limited to a table showing the number of species of each natural order, including naturalised species. A rough calculation of the number of indigenous species of vascular plants, described or enumerated, gives a total of about 1100, whereof 200 are ferns, and 172 are orchids. This is nearly 250 higher than Baker's estimate (61) of the vascular plants of Mauritius; but, although the islands are nearly of the same size, the mountains of Bourbon rise to altitudes of between 9000 and 10,000 feet, or about 6000 feet above those of Mauritius; thus giving an additional climatic zone to the former island. And an analysis of the components of the flora shows that Bourbon possesses a much larger temperate element. But it should be known that Cordemoy takes a narrower view of species than Baker, especially in ferns; and some allowance would have to be made for this in comparing the totals. Apart from this divergence, the flora of the two islands is essentially the same, several genera and many species being common to both and found nowhere

else. The predominating natural orders of vascular plants occupy nearly the same positions numerically in both islands ; ferns being first and orchids second, and Leguminosæ and Compositæ relatively low down ; very different proportions from those obtaining in the Madagascar flora, in which these four orders occupy reversed positions. Thus : Leguminosæ, Filices, and Compositæ, followed by the Orchideæ, which are represented by just half as many species as the Leguminosæ.

The absence of a number of natural orders from Dr. Cordemoy's *Flora* that are represented in Mauritius may be accounted for partly by the fact that he did not work out the old collections made before the destruction of the virgin forests which formerly clothed the island. It is probable that many species have disappeared from both islands from the same cause. The following orders known to be, or as having been, represented in Mauritius are not included by Cordemoy : Xyridaceæ, Scitamineæ, Podostemaceæ, Myoporineæ, Bignoniaceæ, Lentibulariaceæ, Gentianaceæ, Rhizophoreæ, Connaraceæ, Simarubaceæ, Ochnaceæ, Burseraceæ and Nymphæaceæ. The absence of several of the foregoing orders might be accounted for without calling in the theory of destruction, but it would lead too far to attempt the discussion of the matter here. *Myoporum mauritianum* is an instance of a plant, and an order that is no longer represented, if it ever were ; for there may have been an error in locality. The only specimen at Kew is labelled as coming from one small patch at the east end of the island of Rodriguez, which is some 300 miles distant from Mauritius. Moreover the Seychelles and Rodriguez between them possess several natural orders which do not reach Bourbon or Mauritius, though they are represented in Madagascar. They are Nepenthaceæ, Passifloraceæ, Turneraceæ, Diptero-carpeæ (?), Ternstroemiaceæ and Dilleniaceæ ; whereof the first and the fourth are essentially Asiatic, the second and third American, and the two last equally Asiatic and American. The parasitical Rafflesiaceæ are perhaps the only natural order in Bourbon that is not represented in Mauritius. Cordemoy records *Hydnora africana*

as common at St. Paul in Bourbon. It inhabits Eastern tropical and South Africa, though it is not known from Madagascar or any other of the African islands. Six or seven species of *Hydnora* have been described; all inhabiting Africa from Abyssinia and Angola southward to Cape Colony. I have previously noted (62) the discovery of a member of this order (*Cytinus Baroni*) in Madagascar. Since writing that I have seen a third Mexican species.

The intimate relationships of the floras of Bourbon and Mauritius may be gathered from the presence in the two islands, and restriction to these islands, of the following monotypic, mostly very distinct, genera: *Cossignya* and *Doratoxylon* (Sapindaceæ), *Grangeria* (Rosaceæ), *Roussea* (Saxifragaceæ), *Psiloxylon* (Lythraceæ?), *Fernelia* (Rubiaceæ), *Heterochaenia* (Campanulaceæ), *Bryodes* (Scrophularineæ), *Monimia* (Monimiaceæ) *Dictyosperma* (Palmæ). To these may be added several other genera of the same geographical area, represented by more than one species; in five instances out of six by three species: *Fætidia* (Myrtaceæ), *Pyrostria* and *Myonima* (Rubiaceæ), *Faujasia* (Compositæ), *Hyophorbe* and *Acanthophœnix* (Palmæ). Twenty-five other characteristic genera are restricted to the African region, using that designation in the sense of including therein the islands under consideration, Madagascar, and continental Africa. *Trochetia* (Sterculiaceæ) is remarkable among them as extending to St. Helena, where it is represented by two distinct species—or rather was, for one is quite extinct in a wild state. *Psiadia* (Compositæ) has the same range.

Allusion has been made (63) to the phenomenal concentration of endemic palms in the Seychelles, and it would be interesting to give the distribution and affinities of the palms of the whole of the East African Islands; but I must confine myself to the Bourbon species. The native species are five in number, namely: *Latania Commersonii*, *Hyophorbe indica*, *Dictyosperma album*, *Acanthophœnix rubra* and *A. crinita*. All these palms also inhabit Mauritius, and they are, so far as our present knowledge goes, confined to the island. All the genera are peculiar to this insular region if we take in Madagascar, and *Dictyosperma* and *Acan-*

thophaenix to Mauritius and Bourbon. *Latania* belongs to the Borasseæ and all the rest to the Arecineæ. As stated before, there is no parallel to this in insular floras of other parts of the world. Polynesia, both the eastern and western, is relatively poor in palms, and the West Indian Islands possess few endemic species; but, as explained a few pages back, Lord Howe Island possesses four endemic species of palms belonging to Australian and endemic genera.

Coming down to species we find that Cordemoy describes about 200 new ones, which, with those previously known as endemic, would make probably not less than 25 per cent. of the vascular plants endemic. It is probable that this number—the number of new species—may be subject to some reduction, especially in such groups as the ferns and grasses in which so many species have a wide range; yet 25 per cent. of endemic species is possibly below rather than above the mark. Nineteen grasses are described as new. Considering, however, the general distribution of grasses, and that only four species are regarded as endemic in Mauritius, there are good grounds for suspecting that many of the Bourbon species are not really new.

Orchids, epiphytal and terrestrial combined, contribute no fewer than seventy new species; and the total number of orchids thus exceeds the total indigenous species of any other two natural orders. In Mauritius, orchids are more numerous than any other order of flowering plants, but they only occupy the first place by a majority of about ten. As I have shown elsewhere (64) orchids are exceedingly rare or entirely wanting in oceanic islands, and such proportions as Cordemoy's enumeration gives would hardly be found in the richest orchid districts of Asia or America. Continental tropical Africa, so far as known, is relatively poor, whilst in Madagascar, according to Baron's tabulation (65), orchids stand third, being exceeded by Compositæ and Euphorbiaceæ. It is true that I have estimated (66) that orchids are numerically more strongly represented in British India than any other order of flowering plants, and my estimate has proved correct in the subsequent elaboration of this order (67) by Sir Joseph Hooker. It may be in-

teresting to add that orchids stand third in the flora of the whole world, and they also take the same position in the flora of Mexico and Central America.

Returning to the Bourbon orchids; the regional characteristic *Angræcum* is credited with eighteen new species, and a total of thirty-two species. There are also new species of the epiphytal genera *Bulbophyllum*, *Aeranthus*, and *Saccolabium*; but the bulk of the new ones are terrestrial plants, many of them very rare and inconspicuous, and most of them of short duration above ground.

On this point Cordemoy says: "J'en ai moi même plusieurs nouvelles, en herbier, que leur mauvais état de conservation ne permet pas de décrire. Certainement il en existe d'autres non encore découvertes, surtout parmi les Ophrydées, dont plusieurs parcourent, en quelques semaines, la période active de leur végétation, puis se replient immédiatement, pour passer le reste de l'année sous terre à l'état de tubercule. Plusieurs localités n'ont pas été suffisamment explorées."

Three new genera of this group are described, namely, *Acrostylia*, *Camilleugenia* and *Hemiperis*; the first two being monotypic and the third having twenty-one species ascribed to it. All three would be included under *Habenaria* by some authors; but in this extended sense *Habenaria* is a vast and heterogeneous agglomeration of species.

Among other genera, of which several new species are described, I may mention *Dombeya*, *Evodia*, *Eugenia*, *Embelia*, *Sideroxylon*, *Geniostoma*, *Psiadia* and *Faujasia*.

In addition to the new genera of orchids, four others are proposed, namely, *Guya* (Bixaceæ), *Herya* (Celastraceæ), *Allocalyx* (Scrophulariaceæ), and *Mahya* (Labiataë). According to the author's own admission, three out of the four are somewhat doubtful, and the affinity of the fourth is not given more definitely than by placing it in the tribe Mentheæ. But *Mahya stellata* is an interesting plant, whatever its affinity, because it is believed to be the only really indigenous member of the Labiataë. It is a dwarf shrub, very rare, and found only near the summit of the Grand Bénard, at an elevation of about 8650 feet.

Strange to say the upper zone of vegetation is less alpine in character than that of the mountains of Madagascar and Tropical Africa. Cruciferæ, Caryophylleæ, Umbelliferæ, Primulaceæ and Gentianaceæ, as well as herbaceous Rosaceæ and Saxifragaceæ, are either exceedingly rare or entirely absent. In Madagascar, where the highest point is barely 8500 feet, the following familiar genera occur: *Ajuga*, *Alchemilla*, *Caucalis*, *Crassula*, *Drosera*, *Epilobium*, *Genista*, *Geranium*, *Linum*, *Pimpinella*, *Sanicula*, *Stachys*, and *Viola*, besides many others which are unknown among the native plants of Bourbon.

Gymnosperms are also unrepresented, both in the indigenous vegetation, and among the numerous naturalised plants. It is the same in Mauritius; but in Madagascar one species each of *Cycas* and *Podocarpus* has been discovered; the latter being prominent in certain districts.

Finally, I may add that the following orders are strongly represented in the Bourbon flora: Malvaceæ (*Dombeya*, 21 species, and *Ruizia*, *Astiria*, and *Trochetia*, regional genera); Rutaceæ (*Evodia*); Urticaceæ (*Ficus*, and *Obetia* and *Maillardia*, regional genera); Euphorbiaceæ and Convolvulaceæ.

Since the untimely death of Dr. H. Baillon another part (68) of the admirable illustrations of the flora of Madagascar has appeared. It consists largely of plates for intercalation, and the highest number is 340. Unfortunately no descriptive or explanatory letter-press has been published in connection with these plates and none is likely to be forthcoming. Surgeon-Major H. H. Johnston has published (69) an enumeration of plants collected by himself and regarded by him as indigenous in Mauritius, though they are not included in Baker's *Flora*. The total is fifty species, half of which are cellular cryptogams. There is nothing specially remarkable amongst them. The same gentleman has published an account (70) of the vegetation of the small islands in the Mahébourg Bay, Mauritius, namely: Ile de la Passe, Ile Vakois, Ile aux Fouquets, Ile aux Fous, Ile Marianne and Rocher des Oiseaux. These islands are of coralline limestone forma-

tion, and their flora is equally as poor, and composed mainly of the same species as the flora of the small coral islands of the Pacific Ocean, a specimen of which is given some pages back.

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SELECTION IN MAN.

QUESTIONS respecting the origin and development of race-types have been among the favourite battle-grounds of anthropologists since anthropology began to be. Some have held that the countless varieties of type in man could be accounted for by the simple admixture of a very few original types, of three for example, a white, a black and a yellow one, others that nothing was needed to produce the widest extremes of variation save the direct influence of what the French call "media" and the Americans environment. With the development and increasing prevalence of evolutionary theories, the questions were looked upon from a somewhat different point of view. The same two parties, however, continued to exist, the one assigning supreme importance to innate variability controlled by natural selection, the other to the same variability controlled by environment. In process of time it became obvious that there might be other selective agencies than those commonly understood by the term natural; and Alfred Wallace himself pointed out that natural selection must have been potent in its working on man in the early stages of civilisation, but that in later stages it ceased to be so, while other agencies came into play.

Questions dependent on, or arising out of those already mentioned are innumerable, and in some instances at least are of obvious and immediate practical importance. For example: Which are the types of man that are most suitable for colonisation or acclimatisation in different parts of the world? and are they recognisable by colour or form of head, by cephalic or nasal index, by stature or any other visible character? What is the connection or relation, if any, between complexion and liability to malarial fever, to syphilis, to cancer or leprosy? Are the more fertile types or strains of mankind to be known by outward signs? Are new types of man likely to be developed more suitable than those now prevailing to the altering conditions of civic and industrial life, and if so, through what agencies?

Let us begin with the subject of complexion or colour, because it is one of the most conspicuous differential characteristics of man. The xanthochroic type of Huxley, the blond, at present so dominant and aggressive, occupying, in conjunction it is true with the melanochroic (or dark white), more and more of those parts of the earth, such as North America, Australia and South Africa, which have hitherto been the patrimony of the brown or the black man—is there reason to expect that it will hold its own outside of its original habitat, or even there?

The historical evidence is on the surface at least unfavourable. If we take the words used in their most natural sense, we must allow that the Greeks and Romans described not only the Germans but the Gauls and Thracians as blond. And they did not mean simply that the blond complexion was pretty common among these northern people; that could hardly have struck them as very remarkable; for if they had not had among themselves pretty frequent examples of it, their descriptions of the four temperaments could hardly be explained.¹ Literary portraits, and personal names such as Flavius, Rufus, Ahenobarbus, leave no doubt that there was considerable variety of complexion among the Romans of the republican period, though dark hues may have prevailed; and it does not appear that the continual influx of northern blood has been able to do much, if any, more than to maintain the status in that respect. The Greeks ascribed yellow locks to Achilles and Menelaus and other chieftains of the heroic age; but in the imperial age the Egyptian limners represented Greek ladies with black hair and eyes. The ballads of Mount Rhodope, believed to be of extreme antiquity, and referring to Philip, Alexander, and even Orpheus, ascribe yellow hair to their heroes; but the Pomaks of the Rhodope are not now a blond race.² Another argument may be derived from the ancient Egyptian wall-paintings. Not only

¹ Among the marks of the sanguine and lymphatic temperaments light hair is generally mentioned, while black hair belonged to the choleric and the melancholic.

² Fligier.

the Lebo or Tahennu and the Amorites (both probably enough of North-European origin, though domiciled in Lybia and Canaan), but some of the Arabian Shashi are represented as of xanthous complexion. Yet now-a-days we hear nothing of blonds in the Arabian or Egyptian populations, except where recent admixture of blood may be suspected. Again, Flinders Petrie's recent discovery of the remains of a tall, brown-haired, and apparently "Aryan" population in Middle Egypt,¹ that seems to have completely and speedily disappeared, reminds us of the generally accepted statement that the Mamelukes have no representatives in the Egyptian population at the present day. On the other hand the alleged blond coloration of the Guanches in the Canary Islands, and the known frequency of that complexion in the people of the Riff, and in the Kabyles of some mountainous regions further east, make it probable that the type of the Tahennu still exists where climatic conditions are not unfavourable to it. And after all, these Tahennu may have been only a blond military aristocracy ruling a melanochroic plebs; had it been otherwise, allowing that they had come from the north, why did they not perpetuate an Aryan language in North Africa?

Again, the large xanthous element in the Jews has been accounted for by the existence of an ancient Amorite cross; and on the whole this appears to me the most probable explanation. We can hardly doubt its antiquity in any case, since it is present in every section of the Jewish people, and is very distinct among the Sephardim of the Levant, though perhaps larger in proportion among the Ashkenazim,² whose Gentile neighbours are so largely blond. In some parts of the Levant, indeed, among the dark Turks and Armenians, a red beard raises a suspicion of Hebrew ancestry.

On the whole this kind of evidence, of which much

¹ "Indications of the earliest English occupation of Egypt," as De Lapouge pointedly remarked.

² Jacobs and Spielmann, *Anthrop. Trans.* Beddoe, *Ethn. Trans.*

more might be adduced, leads me to think that though selective agencies in the warm Mediterranean regions are on the whole adverse to the perpetuation of the blond type, they are not so everywhere or in very high degree.

Most of what evidence we have from northern countries makes one doubt whether any change has occurred except through immigration from melanochoic areas, and consequent admixture of blood. The Icelandic Sagas show that the Norsemen in the tenth century were as diverse in colour of hair as they are now; in fact the number of persons qualified as "black" would be a little surprising, if one did not allow for the probable inclusion of some whose hair was really only dark brown. The carefulness of the descriptions is vouched for by coincidences; thus, chiefs with a mixture of Irish blood, such as Skarphedinn and Kjartan, betray it by some Irish feature. The eyes are seldom mentioned; but Egil Skallagrimson, a pure Norwegian, had black eyes.

Similarly the old Irish poems and legends testify to the occurrence of the same varieties of complexion that now exist, and particularly to that of the very Irish combination of blue eyes and black hair, which is ascribed among others to the famous Diarmaid O'Duibhne, the semi-mythical ancestor of the Campbells.

Nevertheless I hold to the opinion, though only as an opinion, not as a firm belief, that the modern Norsemen are, if anything, more generally blond than their ancestors, and the modern Irishmen less so. If Scandinavia was, as now-a-days many think, the officina or breeding-ground of the blond long-headed type, may not the same agencies which worked in that direction after the close of the last glacial period be still operating there now, though it may be less powerfully? As for the Irish, it is certainly curious that no early English writer, so far as I am aware, makes mention of their dark hair. As I have said elsewhere, Giraldus tells us that the Welsh were of swarthy complexion, but he says nothing about the colour of the Irish (though he had much to do with them), except that incidentally and casually he says something about "long

yellow hair, like the Irish". The Irish colony about Dinas Mawddwy, in Merioneth, were called "the *red* men of Mawddwy". It is probable that the ruling tribes of Ireland had much more of the blond element than the servile ones;¹ and that the former were exhausted by the long wars with the English, by the military emigrations to France and Spain, and perhaps the earlier emigrations to America. Dr. Morton, the first great American anthropologist, in describing the Irish as he saw them, said "eyes and hair light". But there is no doubt that, speaking broadly, there is more dark hair in Ireland than in England or Scotland, though there are more dark eyes in England. The climate of Ireland, cloudy, moist and temperate, should favour the depigmentation of the eye by natural selection, and I have pointed out that the English colonists of Ireland by mixing their blood with that of the natives have changed their own type more in the direction of lightness of eye than of darkness of hair.

Mr. Galton has pointed out how rapidly a community in which the age of marriage is late would, under like circumstances, be crowded out or superseded by one in which that age is some years earlier. This consideration is one of several which account for the rapid extinction of upper class families in these islands, while the proletariat multiplies with inconvenient rapidity; and as the blond type is more prevalent in the upper than in the lower classes, it also is probably in process of diminution. If, however, it can be shown that the blond is more subject, *in this country*, to diseases of such a nature as to shorten life, and reduce the duration of the period of child-bearing and child-beggetting, this same result would follow. Now there is a good deal of evidence as to the greater liability of blonds to certain classes of disease (in America at least), in Baxter's great work on the medical statistics of the Civil War. There are certain possible fallacies which may underlie Baxter's figures, to some of which De Candolle

¹ Thus MacFirbis, in a well-known passage, describes the Tuatha De Danaan as fair, and the Milesians as "white of skin, brown of hair," but the Firbolgs as a servile race, and black-haired.

has directed attention ; but if we assume that the conclusions which result from them are at all approximately correct, it follows that the blonds in America have less chance than the brunets of contributing their due proportion to the next generation. Under these conditions the blonds ought to diminish relatively, and the brunets to increase ; and accordingly we find that of accepted soldiers there were among the white natives of the United States about (per cent.)

		66 light and 34 dark complexioned, but			
among the English	70	„	30	„	
„ Irish	70	„	30	„	
„ Germans	69	„	29	„	

Thus the men of American birth yielded a larger proportion of brunets than those of any of the nations that had most largely contributed to their ancestry, which is nearly equivalent to saying that the Americans are more generally dark complexioned than their ancestors were. Gould (quoted by Ripley) found that the natives of the eastern states were also darker than those of the west. But whether this last fact is occasioned by the parentage of the western men being more directly European, or whether it is connected with the more migratory character of the blond type, must be left for the present undetermined.

Of European evidence on the relation of complexion and disease there is, so far as I am aware, no great amount. My own observations have shown that it is a mistake to suppose, as many do, that light-haired persons are in England more liable to phthisis than others. I have also pointed out that cancer is more common in persons of dark complexion, and in this I am supported by the observations of Dr. Roger Williams. This last fact has, however, very little bearing on the subject in hand, for as cancerous disease usually attacks persons who are beyond the child-producing age it can have very little effect on the proportions of the different complexions of the next generation.

As we possess for France not only elaborate recruiting statistics, with numerical lists for the principal disqualifying

diseases, but also Topinard's departmental statistics of colour, and Collignon's of head-breadth, and Bertillon's of mortality, one ought, it would seem, to acquire therefrom some solid grounds for the connection of physical types with disease, and for the estimation of their comparative liability, and of the probable results in the direction of selective propagation. In reality this turns out to be extremely difficult. "The prime difficulty" in such questions "is that these two factors, material prosperity and ethnic intermixture, in most cases follow the same laws of geographical distribution."¹

Thus in France the conquering races, in most of which blond types originally prevailed, occupied, as a rule, the most fertile tracts, which were also generally the most level and those contiguous to the great ways of communication. It is in such tracts that civilisation usually progresses fastest, that great cities arise with their vices and sanitary disadvantages, and that blood is most mixed by continual migration and marriage. All these circumstances and conditions have to be taken into account before we can undertake to say anything as to the correlation of physical type with disease or military aptitude. The most promising plan seemed to me to be the throwing together of a number of departments having all *one* common character, but otherwise differing variously. The results thus gained are, however, more curious than conclusive. French anthropologists generally describe the tall, blond, long-headed type as subject to dental caries and myopia, and some add hernia to the list of its defects. Now the six departments, Nord, Pas-de-Calais, Somme, Aisne, Oise, and Calvados, which seem most distinctly to combine in their population all three marks of this type, have indeed a very bad record for dental caries, and, except Calvados, for general military unfitness; but three out of the six stand much better than the average of France as regards myopia and hernia. Moreover, bad teeth in the departments of France, strangely enough, usually co-exist with a low mortality, and I am

¹ Ripley, "Ethnic Influences in Vital Statistics," *Q. P. American Statistical Association*.

disposed to think that both are the outcome of some influences which increase in potency with the advance of civilisation. In any case the frequency of dental caries does not seem to have an unfavourable selective influence.

Phthisis, however, may and does have such an influence. And Houzé, having shown that it is more prevalent among the taller and fairer Flemings than among the shorter and darker Walloons, concludes that it has been the principal agent in producing the supposed reduction of the blond type in Belgium and elsewhere.

Now in England, as I have already stated, the proportion of blonds in the general population is quite as great as among the subjects of phthisis, but that of tall men among the phthisical is greater than that of short men. Let us see how it is in France.

"Pulmonary disease," "scrofula" and weak "constitution" seem to be so often confounded or interchanged in the recruiting statistics, that I have thought it advisable to class the three together, with the following results.

The three together are, or rather were in Boudin's time, the cause of rejection of conscripts in about the following order :—¹

49	in France.		
42	„	10 most blond departments.	
39	„	10 most brunet.	
41	„	10 departments with tallest population.	
44	„	10 „ „ shortest „	
54	„	6 „ „ combination of stature, blond complexion and long head.	
48	„	5 departments with combination of stature, blond complexion and long head, excluding the Nord.	

¹ This is not the correct way of putting it; but we have here the result of averaging the ranks in each of the three classes of disqualification, and counting each of equal value. In reality the number rejected for weakness of constitution is vastly greater than that for scrofula, and that again than for phthisis.

The low position of France as compared with her components is due to the greater and denser population of some of the worst departments, such as Seine and Nord.

43	in 10 departments	most long headed.
43	„ 10 „	most mountainous.
48	„ 10 „	most level but thinly peopled.
52	„ 5 „	most urban.
49	„ 5 „	Normandy.
22	„ 4 „	Brittany.
45	„ 9 „	with population of Auvergnat type.
37	„ 5 „ „ „	„ „ Remolothringian type.

Unquestionably the northern blond type does show badly here, but whether the blond complexion is much in fault is doubtful. The Remolothringian region (= Austrasia, or Champagne and Lorraine), which is one of the most blond areas in France, but brachycephalic, stands extremely well; in Brittany the Morbihan, the *most* blond department, stands best, and in Normandy the Orne, the *least* blond, stands worst.

The low position of the Nord may be compared with that of the ethnologically similar or almost identical Flemish zone of Belgium. Houzé himself ascribes this partly, but not, I think, wholly, to poverty, crowding, sedentary occupation, in fact to a number of causes outside of race.

Another method of inquiry suggests itself. If it be true that the blond type is more susceptible than the brown to the malign influences of urban life, and especially to phthisis, which is largely a disease of crowded city-dwellers, we should find this type less frequent proportionally than the brown in ancient cities. On this point we have a great deal of evidence; the greater part of this is supplied by the great inquest of Virchow into the colours of the school-children of Germany, those of Schimmer in Austria, of Kollmann in Switzerland, and of Vanderkindere in Belgium: we have also the observations on adults in Italy of Livi, and those of myself in the British Isles.

Georg Mayr, analysing the returns for Bavaria, pointed out that the town populations had on the whole a larger proportion of dark eyes, hair, and complexions than

the rural districts, and it appeared to him that this excess could not be accounted for by the larger proportion of Jews in the towns, as it occurred, though perhaps to a less extent, in places where the Jews were few.¹

The subject has not been so carefully worked out for other parts of Germany; but a cursory examination of Virchow's figures shows that there is a larger proportion of dark hair in most of the great cities than in the surrounding rural districts, and this is more decidedly the case with the proportion of brown compared to blue eyes. Of 32 urban communities I find that in

- 11 the proportion of dark hair to fair is greater, and that of brown eyes to blue *much* greater than in the surrounding districts.
- 4 — of dark hair greater, of brown eyes greater.
- 4 — of dark hair greater, of brown eyes greater in less degree.
- 2 — of dark hair equal, of brown eyes greater.
- 2 — of dark hair less, of brown eyes greater.
- 4 — of dark hair about equal, of brown eyes about equal.
- 5 — of dark hair less, of brown eyes less.

These last are Halle, Wiesbaden, Krefeld, Ulm and Metz, most of which are towns which have grown rapidly of late. In the case of Metz the recent additions to the population have been derived from the blond region of Northern Germany. It may be noted that it is in that same blond region, generally speaking, that the most marked examples of the rule just laid down occur,² which fact strengthens the suspicion that the phenomena are largely due to the fact that the populations of these cities are partly constituted by immigrants of dark complexion from southern countries, including the Jews.

In Schimmer's Austrian statistics this last source of difficulty is avoided, the Jews being returned and classified separately from the Gentiles. Of 30 cities separately returned, 15 show a larger percentage of dark hair than their surrounding districts, and 14 a smaller one; in the remain-

¹ Thus it does appear in non-Semitic Nurnburg, though it is much more distinct in Semitic Furth.

² *E.g.*, Münster, Hanover, Altona, Berlin, Posen, Danzig, Elbing, Königsburg.

ing one, Linz, the proportions are identical. So far, then, there is blank disappointment; but when the eyes are examined the case is quite different: 27 cities show a larger proportion of dark eyes than their environs, and 3 only a less proportion.¹ In several of these 27 cases questions of race at once suggest themselves. In the Czechs, as in the Irish, the combination of light eyes with dark hair is common, while it is rare among the Germans. When, therefore, we find that in all the 6 cities of Moravia German is the school language, while in the country districts it is either Slavonic or mixed, and that in every one of these cities the eyes are darker and the hair lighter than in the surrounding districts, we need go no further for an explanation. But this will not serve in all the cases; and some probability remains that there is a certain kind of selection at work to darken the eyes of the urban population.

In Belgium the case is not so clear. Ghent, Antwerp, Ostend, and Verviers come out much darker than their neighbours; in most other cases the differences are slight either way. The cantons in Belgium are generally large, so that it is difficult to separate the urban and the rural populations. I have however picked out 11 cantons in which I think the urban element most greatly preponderates, and the results are as follows.

Of the 11, 9 have a larger percentage of dark eyes than the arrondissements to which they belong, 1 of lighter eyes; and in one, Mechlin, there is equality. But the hair, as in Austrian schedules, comes out about equal; in 6 of the towns it is darker; in 5, including Brussels and Liège, it is lighter. Ghent is, I suppose, the city in which the unfavourable selective influences of urban life (overcrowding, poverty, sedentary occupation, infectious disease, etc.) are likely to have been most intense.

In Switzerland Dr. Kollmann's schedules yield only two instances of a nearly pure urban community, Basel and

¹ Bozen, Bielitz, and Czernowitz (in the Bukowina): they are all comparatively small places, and all near to race frontiers, which may possibly account for the anomaly.

Geneva. Each of them is on a frontier, each is a singularly favourable specimen of a city, and is of little service for our purpose. Both Basel and Geneva have almost certainly a more blond population than that which surrounds them, whether Swiss, French, or German.

In the West of England, according to my own published observations on 3630 adults, mostly hospital patients, of whom 2486 were natives of towns, and 1144 of rural districts, the proportion of dark hair in towns was to that in the country, reckoning by the index of nigrescence, as 31 to 35; but that of dark eyes was as 58 to 49. We have here nearly the same phenomena as those we found to be so common in Germany, Austria, and Belgium.

In the British Isles generally, the drift of my own very extensive local observations (in which the place of birth however was never actually ascertained) was to show that in large towns, especially those with an old settled population, the darker colours both of hair and eyes were more prevalent than in the surrounding districts. This applied to the greater part of Britain, but in parts of the west where the native population is generally dark-haired, *e.g.*, Shrewsbury and Truro, the proportions may be reversed. The British military statistics, so far as investigated, *viz.*, to the number of 13,800 deserters, yield results similar, but not strongly marked. Thus London, Birmingham, Bristol, Newcastle, Brighton, and Portsmouth give an index of nigrescence of 8, against one of 4.9 for the rest of England; the proportion of dark eyes for the towns named being 39.5 per cent., but for the rest of England, 38.7. Edinburgh and Glasgow give together an index of 11.8, the rest of Scotland of 0.3 only, the percentages of dark eyes being 29 and 27.8; and Belfast and Dublin give an index of 18.7 against 15.2 in Ulster and Leinster, with percentages of dark eyes amounting to 32 and 28.4. The figures might be dissected with advantage, but to do so would lengthen this paper inordinately.

Livi's statistics as to this point are perhaps the most interesting, and have the advantage of being founded on the physical characters of adolescents (*i.e.*, conscripts). He

finds that fair hair is more uncommon and dark eyes are more frequent among the inhabitants of cities and their immediate vicinity than among those of the surrounding country. And this applies more or less to the whole of Italy, and cannot, therefore, apparently be accounted for by the immigration of the dark type from southern Italy into the northern cities, where the blond type is more common than in the south.

Thus I find in the northern and more blond region (Piedmont, Lombardo-Venetia, Liguria) 17 urban populations which, on a balance of eyes and hair, are darker than the rural populations around; 3 which are lighter, Brescia, Como, Rovigo; and 1, Verona, where the conditions are equal. In the central provinces, from Emilia to Campania inclusive, 19 cities are darker, 9 are lighter, and 2 are equal. In the south, including Apulia, etc., and the islands, where blonds form a very small minority, 11 cities are darker and 5 lighter. Thus in the north the rule obtains in 82 per cent., in the centre in 63, in the south in 69. The greater darkness appears to affect the eyes and the hair with something like equality, though not uniformly.

Livi, finding that the blond complexion is, with identity or supposed identity of race, more prevalent in the poverty-stricken mountainous districts than in the plains, and putting that fact into connection with its less prevalence in the cities, is disposed to consider it as connected with poor food and hard labour, which may retard development of pigment; in fact, he thinks the deposition of pigment to be an index of force and of development. Of course this is as yet unproven, and there is much to be said for and against the doctrine. But it does seem that we have evidence enough to show that in a great part of Europe the citizens are darker than the peasantry. This may be due to some direct influence of urban life, such as deficient oxygenation of the blood in children, but that seems very improbable. More probably it is due either to some kind of social selection such as Ammon and De Lapouge have studied, or else to the selection of the fittest for town life by the destructive agency of conditions more unfavourable to the

blond than to the brunet child. I propose to follow out the subject further in another article.

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RECENT DISCOVERIES IN AVIAN PALÆONTOLOGY.

FOR reasons long ago pointed out by Lyell, fossil remains of birds are much more rarely found than those of other vertebrates, and, as a rule, occur in a very fragmentary condition. These circumstances, coupled with the difficulty in arriving at accurate determinations, owing to the great general similarity in the skeletal structures in most of the members of the class, have a direct bearing upon the scantiness of the results that have been attained in avian palæontology. In spite of these drawbacks, however, some not inconsiderable additions to our knowledge of fossil birds have been made during the last two or three years, and a short account of the chief papers on this subject may be of some interest. It will be convenient to take the papers roughly in the order of the geological age of the fossils they treat of, and to commence with those relating to the most ancient types.

Pre-tertiary Birds.—Unfortunately, with one exception, no remains of pre-tertiary birds have been discovered during the last few years. This is the more to be regretted because, interesting though many of the tertiary birds may be, they are in all essential respects similar to recent forms, and throw no light whatever on the mystery of the origin and early history of the group, the key to which lies buried in the Jurassic and Cretaceous rocks.

The single exception referred to is an imperfect tibia obtained at Judith River, Montana, from Cretaceous deposits of somewhat later date than those which formerly yielded the remains of *Hesperornis* and *Ichthyornis*. This tibia has been described by Marsh (1), who regards it as indicating a bird about two-thirds the size of *Hesperornis*, to which it is closely related, and has made it the type of a new genus, *Coniornis*, its specific name being *C. altus*.

Tertiary Birds.—In tertiary deposits of various ages and in widely distant localities, some important discoveries of bird remains have been made of late.

From the Eocene of New Jersey Marsh (2) has described some fragmentary bones which he considers belonged to a large struthious bird, *Barornis*, related to *Gastornis* and *Diatryma* from the Eocene of Europe and North America respectively. The specimens seem, however, to be too imperfect to admit of complete certainty as to the affinities of this bird, but it may be remarked that the "struthious" nature of *Gastornis* is very doubtful, though it was probably "ratite" in the morphological sense of that much abused term.

A portion of a metatarsus obtained in Vancouver Island from a deposit of Eocene or, at latest, Oligocene age, forms the subject of a memoir by Cope (3). This author, after an exhaustive comparison with recent types, comes to the conclusion that its affinities lie in the direction of the *Steganopodes*, and that of these *Pelecanus* is the nearest ally of the extinct form, to which the name *Cyphornis magnus* has been given. The presence of a large pneumatic foramen on the anterior face of the bone is strongly in favour of this view, and if, like the Pelicans, *Cyphornis* was capable of flight, it is by far the largest flying bird hitherto recorded.

A most important addition to our knowledge of the avi-fauna of the earlier tertiary rocks of Europe has recently been made by Professor Milne Edwards, to whom students of this branch of palæontology are already more deeply indebted than to any other writer. In a paper (4) read at the Ornithological Congress at Buda Pesth, he described a number of bird remains from the well-known deposits of phosphate of lime (Phosphorites) which occur in the neighbourhood of Caylus (Lot) in Southern France. The mammalian fauna of these deposits, described by Filhol and others, is an extremely rich one, and Lydekker has shown that several characteristic members of it occur at Hordwell in Hampshire in strata of Oligocene (Up. Eocene) age.

The birds now described belong to some seventeen genera, of which ten are new; these include representatives of several sub-orders. Only the more interesting of the new forms need be noticed here.

Of these perhaps the most important is *Archæotrogon*, which is closely related to the Trogons, and may indeed be an ancestral form of the genus *Trogon*, an extinct species of which has been recorded from the Miocene of Allier. At the present day these birds occur in the Neotropical, Ethiopian, and Indian regions; and it is remarkable that the extinct Miocene bird of Southern France should belong to a Neotropical genus rather than to one of those found in the Old World. This peculiar distribution of the recent and fossil forms is shown in a still more marked manner in the case of the next genus, *Filholornis*, which is said to be closely allied to *Opisthocomus*. The only known representative of this genus is the Hoatzin (*Opisthocomus cristatus*), which is one of the most peculiar and isolated forms of Carinate birds now living. It occurs only in Guiana and the Amazonian region, and is referred to a separate sub-order of which it is the only member. It is usually regarded as a primitive type, and the occurrence in Europe of a closely related bird is, therefore, another of those numerous cases in which such generalised types, now found only in the Southern hemisphere, have extinct representatives in the Northern. That the determination of the affinities of *Filholornis* is correct there seems to be no doubt, since Milne Edwards states that its ulna is almost a *fac-simile* of that of the Hoatzin, in which that bone is of a peculiar and distinctive form.

In the same memoir several new ralline birds are added to the already numerous rails recorded from the Tertiaries of France. One of the new forms, *Rallus dasypus*, though much smaller, is said to resemble *Ocydromus* in the form of its humerus; and another, *Elaphrocnemus*, a new generic type, approaches *Aphanapteryx* in the structure of its metatarsus. The occurrence in the lower Tertiary deposits of Europe of a large number of rails seems to be rather a strong argument in favour of a northern origin of the group, which, as Milne Edwards points out, is an extremely ancient one, of which at the present day we are only acquainted with some more or less degenerate descendants. Many of the more modified forms, such as *Ocydromus* and *Aphanapteryx*,

are now confined to, or have recently become extinct in, the Southern hemisphere. Between these and the primitive generalised rails there must have been many intermediate forms, one of which, in the opinion of Milne Edwards, is to be found in this new genus, *Elaphrocnemus*.

Other new genera of which the affinities are more doubtful are *Orthocnemus*, which resembles the Storks and Bustards in some respects and the Rails in others, and *Tapinopus*, which seems to have been a short-legged wading bird. We may also notice *Necrobyas*, a genus of owls presenting a combination of characters not found in any recent form; *Tachyornis hirundo* (previously described by Lydekker as *Ægialornis gallicus*), which is referred to the *Cypselidæ*; *Dynamopterus velox*, a cuckoo closely resembling *Eudynamis orientalis*, an inhabitant of the Austro-Malayan region; *Geranopterus*, allied to the Rollers and Momots; and, lastly, *Pterocles validus*, a sand-grouse considerably larger than any recent species.

Although many of the genera and species above noticed are founded on single or, at best, a very few bones, still in the hands of one so experienced in avian osteology as Professor Milne Edwards such material is sufficient for a fairly certain determination of the affinities of the fossil forms; and in this case the importance of the results from the point of view of geographical distribution cannot easily be over-estimated. It is much to be regretted that this valuable paper is not illustrated, since even the most careful descriptions of bird bones are very unsatisfactory without figures.

From the Middle Miocene of La Grive-St.-Alban in South-Eastern France, Lydekker (5) has described a small collection of bird bones. These, which do not include any very striking novelties, are referred to a new species of Owl, a large Pheasant, previously recorded by Milne Edwards from beds of about the same age at Sansan, a number of quail-like birds (*Palæortyx*), a Sandpiper and an undetermined Picarian bird.

The next addition to the ranks of fossil birds to be considered is by far the most important that has been

made since Marsh's discovery of the Toothed birds of North America. In this case Patagonia, a region long known for the wealth and peculiar character of its fossil Mammalia, has yielded a number of the most extraordinary avian types yet known. The discovery of these is due to Dr. F. Ameghino and his brother, to the former of whom we are indebted for the most complete account of them that has yet been published.

The first mention of the existence of gigantic extinct birds in Patagonia occurs in a letter from Carlos Ameghino, published in the *Revista Argentina de Historia Natural*, April, 1891, and containing a report of the results of his collecting expedition in Patagonia.

Some years before this (in 1887) F. Ameghino (6) had described under the name *Phororhacos longissimus* the symphysial portion of a large mandible which he considered to belong to an edentate mammal; a portion of a cranium, the type of the genus *Tolmodus*, was also referred to a member of the same class. In 1891, however, thanks to the new and better material obtained by his brother, he was able to show clearly (7) that both these specimens were in fact portions of the skeletons of gigantic birds, and to give a fairly complete diagnosis of the genus *Phororhacos*. In some points, as for instance in the statement that teeth were present, and that there was a bony helmet-like crest on the skull, this diagnosis, as Ameghino himself afterwards showed, is not quite correct; but it was the first definite statement of the chief characters of these extinct birds. The mandible was shown to be of enormous size and to curve upwards at its anterior end in a manner almost unique among birds; for though *Psophia* and *Dicholophus* were compared with it in this respect, they do not in fact possess this character. The upper mandible forms a strong hooked beak like that of a raptorial bird.

In the same year (1891) Moreno and Mercerat published a catalogue of the fossil bird remains in the La Plata Museum (8). This was illustrated by a large series of very beautiful photographic plates, but unfortunately these were unaccompanied by any adequate description of

the specimens. Several extinct penguins of the genus *Palæospheniscus*, from so-called Oligocene beds, as well as a number of Pleistocene bird remains, were figured in this work, but by far the most important section is that dealing with the great flightless birds of the Santa Cruz Beds. For the reception of these the authors established a new order, the *Stereornithes*, which was subdivided into four families, the *Brontornithidae* (including the genera *Brontornis* and *Rostrornis*), the *Stereornithidae* (with *Phororhacos*, *Stereornis* *Mesembryornis* and *Patagornis*), the *Dryornithidae* (with *Dryornis*) and the *Darwinornithidae* (with *Darwinornis* and *Oweniornis*). *Psilopterus* (a name which, being preoccupied, was afterwards changed by Ameghino to *Pelecyornis*), a genus probably related to *Phororhacos*, was placed in the *Cathartidae*.

At the end of the same year Ameghino published a synopsis of the South American fossil birds (9) in which he severely criticised the classification given above. He asserts that nearly all the new genera are merely synonyms of *Phororhacos*; the only exceptions being *Brontornis* which includes *Rostrornis*, and *Psilopterus* (*Pelecyornis*) which embraces *Patagornis*. Examination of the figures given by Moreno and Mercerat shows that in many cases, at least, he is right; for instance *Stereornis* is clearly the same as *Phororhacos*. On the other hand *Dryornis*, the sole member of the *Dryornithidae*, is founded on the distal end of a humerus, which, judging from the figure, is probably that of a large vulture, most likely the Condor; it may be pointed out that this specimen is not from the Santa Cruz Beds but from a Pleistocene deposit.

In this paper Ameghino himself refers all these flightless birds to two families, the *Pelecyornithidae* (including *Pelecyornis* and two new genera, *Lophiornis* and *Anissolornis*) and the *Phororhacosidae* (with *Brontornis*, *Phororhacos*, and a new genus, *Opisthodactylus*). All these he regards as *Ratite*, and in this he was followed by Gadow (10) and Lydekker (11). Subsequently the latter of these writers, relying on the fact that the quadrate in *Phororhacos* pos-

sesses a double head for articulation with the skull, changed his opinion, and now considers them as degenerate Carinatae in which the wing has been reduced in size.

Till recently our knowledge of the *Stereornithes* depended almost entirely on the preliminary notices of Ameghino, and on the plates of the catalogue of Moreno and Mercerat. At the beginning of last year however the former author published by far the most important contribution (12) to this subject that has yet appeared. He now described not only the specimens to which his preliminary notices referred, but also a large number of additional remains. The classification followed in this paper is different from that in his "Enumeracion," the order *Stereornithes* being adopted and subdivided into two families, the *Phororhacidae* and *Opisthodactylidae*. In the former *Pelecyornis* and *Lophiornis* are now included, while *Anissolornis* is considered to be a Gallinaceous bird: several new genera, some of which appear to be of rather doubtful validity, are also added. The *Opisthodactylidae* include one genus only, *Opisthodactylus*.

Of the *Phororhacidae* the skeleton of *Phororhacos inflatus* is by far the most completely known, the skull, mandible, pelvis, the bones of the fore and hind limb, and some vertebrae being described and figured. The skull is of a very remarkable appearance; from the side it most resembles that of a Raptorial bird, the enormous beak being sharply hooked at the anterior extremity, but when looked at from above it is seen to be much compressed, so that the premaxillary region, though very deep from above downwards, is extremely narrow from side to side. The quadrate has a double head for articulation with the skull, a character which, as Lydekker has pointed out (13), is opposed to the inclusion of these birds in the *Ratitae*. The mandible is very heavily built, and its anterior end is curved upwards in a manner very unlike the ordinary avian mandible. The sternum is, unfortunately, quite unknown, but the coracoid and scapula have been preserved. The former is long and slender, quite unlike that of any Ratite bird; the acro-coracoid process is almost entirely wanting, and

the only avian coracoid which at all resembles the fossil in the form of its upper end is, I believe, that of *Aptornis*. The wing-bones are very small in proportion to the size of the bird, but, at the same time, are stout and strong; the ulna bears a number of tubercles marking the points of insertion of the secondaries. The pelvis is long and narrow, but in the posterior half, at any rate, it has been somewhat crushed, so that in fact it is broader than would appear from Ameghino's figure. The hind limb is long and comparatively slender; in the tibia there was a bony extensor bridge, and in the metatarsus the hypotarsus is simple. All the above details are taken from the skeleton of a single individual of the smaller species, *Phororhacos inflatus*, in which the skull is about thirteen inches long. In these birds the head is proportionately very large, and this species probably only stood about three feet high at the middle of the back. *Phororhacos longissimus* is about twice as large, the skull being two feet long and about ten inches high. Of the other genera *Pelecymnis* is the best defined, the pelvis and most of the limb bones being known. As already mentioned this genus was placed by Moreno and Mercerat among the *Cathartidae*; and though there is little doubt that this is incorrect, it is by no means clear that Ameghino is justified in placing it in the *Phororhacidae*, the pelvis being strikingly different from that of *Phororhacos* and the wing proportionately so much larger that it was probably still efficient as an organ of flight. The other genera of the family are for the most part known only from mere fragments of limb bones. *Brontornis* is a much larger and more heavily built bird than the largest species of *Phororhacos*, and *Opisthodactylus* is chiefly remarkable for the peculiar position in which Ameghino supposes the hind toe to have articulated with the tarso-metatarsus. In this paper also several extinct Penguins are described, as well as a number of ordinary Carinate birds belonging to several families.

Lydekker points out (14) that the age of the deposits in which these avian remains are found is probably much over-estimated by the South American writers, and that they are probably Miocene. He also discusses the relationship be-

tween the *Gastornithidæ* of the Eocene of Europe and the *Stereornithes* to which that family has been referred, and concludes that though it is not impossible that some affinity between them may exist, its nature is quite uncertain.

In a notice of the same memoir (15) the present writer has compared the skeleton of *Phororhacos* with several other types, and a considerable degree of resemblance with the *Cariama* (*Dicholophus*) was found to exist, particularly in the structure of the metatarsus. If further investigation of the specimens themselves should confirm these observations, the *Cariama* would appear to be related to these gigantic and highly specialised extinct birds somewhat as the recent *Armadillos* are to the extinct *Glyptodonts*. In both cases the recent forms cannot be regarded as direct descendants of the fossil giants, but rather as more generalised descendants from the same common stock, which have escaped extinction both on account of their smaller size, and more particularly, because being less specialised they were less affected by changes in the conditions of life.

The specimens described by Ameghino have been purchased by the Trustees of the British Museum, and many of them may now be seen at the Natural History Museum.

No papers of importance dealing with upper tertiary birds have appeared within the time to which this review is limited.

Quaternary Birds.—During the last three years some important additions to our knowledge of the extinct struthious birds of Madagascar, the *Æpyornithidæ*, have been made. Until 1893 only the bones of the hind limb and some imperfect vertebræ of these birds were known, and no paper describing new material had appeared since the publication of Milne Edwards and Grandidier's classical memoir in 1870. In 1893 Burckhardt (16) gave a very detailed account of a small collection of *Æpyornis* remains that had been obtained at Sirabé in Central Madagascar. This included not only limb bones and vertebræ, but also the greater part of the pelvis and sacrum; all the specimens were referred to a new species, *Æ. Hildebrandti*, which the author compares with those previously known and with the

other *Ratitæ*. The conclusions he arrives at are of considerable interest. Milne Edwards and Grandidier expressed an opinion that *Æpyornis* is related to the *Dinornithidæ*, coming between that family and the Australasian Ratites, *Casuarius* and *Dromæus*, the latter of which according to some writers is the most primitive of the group. Burckhardt also considers that *Æpyornis* is most closely related to *Casuarius* and *Dromæus*, but believes that the resemblances between it and *Dinornis* are merely the result of parallelism in evolution, the skeleton in both cases having become extremely massive. On the other hand, he believes that in some of the characters of the pelvis and other parts of the skeleton, and also in the structure of the egg-shell, *Æpyornis* approaches *Struthio*, and suggests that from the primitive *Dromæus-Casuarius* stock the *Dinornithidæ* and *Apteryx* were descended on the east, while towards the west a branch arose which split up into the *Æpyornithidæ* and *Struthionidæ*. This view, though it may perhaps appear to be supported by the geographical distribution of the families concerned, cannot be regarded as established. The structure of the skull and shoulder-girdle and sternum when known will probably settle this question.

At the beginning of 1894 the present writer described (17, 18) a species of *Æpyornis*, *Æ. Titan*, far larger than any then known. The tibia is about thirty-one inches long, enormously massive, even more so than that of *Pachyornis elephantopus*. In January of the same year Milne Edwards and Grandidier (19) published a preliminary notice of a very large collection of *Æpyornis* remains. They name some four or five new species of *Æpyornis*, and establish a new genus, *Mullerornis*, for the reception of three smaller forms of more slender build than *Æpyornis*. A large part of the skeleton of one of the new species is very briefly described. The skull is said to be less flattened than that of *Dinornis*, and at the same time narrower and longer; the brain was proportionately considerably larger. The mandible somewhat resembles that of *Rhea*, while the sternum approaches that of *Apteryx* in structure. The coracoscapula is small, and bears a shallow glenoid cavity for the

head of the rudimentary humerus. Further descriptions and figures of this valuable specimen will no doubt be of great service in settling the question of the affinities of the family. The authors incline strongly to the view that *Æpyornis* is closely related to *Dinornis*, and, as in their former paper on this subject, suggest the former existence of a land connection between Madagascar and New Zealand to account for this relationship. In conclusion they state that there is clear evidence that *Æpyornis* was contemporary with man, and also mention that remains of a species of *Aphanapteryx* and a large extinct anserine bird occur in the same deposits.

In a later paper (20) the same authors describe in some detail the skull of one of the smaller forms included in the genus *Mullerornis*. This is said to differ widely from that of *Æpyornis*, the cranial region being much less depressed and the frontals raised so as to form a prominent boss. The basi-pterygoid processes are only slightly developed, and the anterior region of the premaxillæ is more compressed and forms a rounded keel above. Of all recent Struthious birds the Cassowary is said to most resemble *Mullerornis*, both in its cranial characters and in many points in the remainder of the skeleton.

An interesting account of the mode of occurrence of the bones and eggs of the *Æpyornithidæ* is given by Mr. J. T. Last (21), who resided in the island for some time and made collections in several localities. It appears that the bones are usually found in the dried beds of ancient lakes or in swamps, where they sometimes occur in large numbers; the eggs, on the other hand, are rarely found in such places, but occur in great quantities (in fragments) in the shifting sand-dunes round the coast.

In 1893 Professor Jeffrey Parker (22) published a new classification of the Moas, founded on the characters of the skulls. This paper is merely an abstract from his important memoir on the cranial osteology of the group, which will be noticed below. Here we need only mention that the *Dinornithidæ* were subdivided into three sub-families, the *Dinornithinæ*, *Anomalopteryginæ*, and the *Emeinæ*, and

that of all the genera *Mesopteryx* is considered to be the least specialised, and retains most nearly the ancestral characters of the family. At the same time it was also shown that some species probably possessed a frontal crest of large feathers, the points of insertion of which are marked by a series of pits on the cranial surface; in some cases this character seems to have been a sexual one.

In the same year Hutton (23) published a paper which may be regarded as an appendix to his important memoir, "On the Moas of New Zealand," which appeared in 1892, and consequently does not fall within the scope of the present review. In this appendix the author states that in his opinion it is necessary to subdivide the various genera of the Dinornithidæ into more species than had hitherto been done; since it is only by keeping the various species and varieties distinct, that the relative ages of the various superficial deposits in which their remains occur can be ascertained. The method of subdivision employed by him seems, however, to be open to the objection that it is an extremely arbitrary and artificial one, for in his former paper above referred to, as well as in the present one, he relies mainly, and in many cases entirely, on measurements of the long bones for separating the species. When we consider that it is possible to trace an almost complete gradation in size between the larger and smaller specimens of any given bone, it is clear that the number of species into which the series is divided, will depend upon personal opinion as to the latitude to be allowed for individual variation. In some cases where small differences in size, accompanied by other slight variations, are constant in two forms from different localities, the careful records and measurements given by Professor Hutton are of much interest and importance, but even in such cases it seems better to regard such small differences as indicating local races rather than distinct species.

Dr. H. O. Forbes (24) has severely criticised Professor Hutton's methods, and points out that in some cases the measurements given for one species fall within the limits assigned to another.

Casts of a number of pieces of limb bones of a small Moa, *Anomalopteryx antiqua*, which were discovered beneath a lava-flow at Timaru, are described and figured by Hutton (25). These specimens were first noticed by Forbes, who states that they were accompanied by remains of *Apteryx*. As to the age of the deposits in which these fragments occur there is much difference of opinion, and they have been successively referred to the Eocene, Miocene, Pliocene, and Pleistocene. Forbes believes that they are Pleistocene or at latest Upper Pliocene, while Hutton regards them as Miocene or Pliocene. In any case the specimens, which have been lost, were so imperfect that conclusions dependent upon them must be received with caution.

In a subsequent memoir (26) by the same author the structure of the axial skeleton in the various genera is discussed, and the descriptions of the various forms of pelvis and sterna are very useful, as also are the references to the published figures of various portions of the axial skeleton of the different forms.

Some ten years ago De Vis announced the discovery in Queensland of a femur of a species of *Dinornis*. The occurrence of the New Zealand type of Ratite bird in Australia would, of course, be a matter of great interest and importance in questions relating to the geological history of two areas; but the great difficulty in accurately determining isolated bird bones made it seem probable that in this case a mistake had been made. This suspicion would appear to be well founded, for Hutton, having had an opportunity of examining casts of the type specimen of the so-called *Dinornis Queenslandiæ*, states (27) that it differs widely from all *Dinornithine* femora with which he is acquainted. He considers that the bone is that of a bird related to *Dromæus* (the Emu), and coming between that genus and *Dromornis*, an extinct Australian form described by Owen.

The most valuable contribution to our knowledge of the morphology of the Moas that has been published for many years is Professor Jeffrey Parker's paper (28) on the cranial

osteology of the group. He has had opportunities of examining a very large number of skulls, some of which are those of young individuals in which the sutures are still open, and has, therefore, been able to give a very detailed account of the structure of this, the most important portion of the skeleton. Moreover, he has given a scheme of classification of the group, founded exclusively on cranial characters; the importance of this is obvious to any one acquainted with the terrible state of confusion into which, for various reasons, the nomenclature of the Moas has got. Five genera are recognised, and it would be very advantageous if these could finally be adopted, particularly as they agree in the main with those accepted by Lydekker in his catalogue of the British Museum collection, which, containing as it does the types of most of the species, must be the final court of appeal in most questions relating to the nomenclature of the family. Professor Parker has added a very detailed comparison of the *Dinornithine* skull with those of the other *Struthious* birds, and arrives at some interesting results as to the relationships existing between the various types. He considers that the *Ratitæ* are a polyphyletic group, *Rhea* and *Struthio* having originated independently of one another and of the forms inhabiting Australia and New Zealand. The latter arose from a common stock which early divided into two branches, the one giving rise to the Australian genera, *Dromæus* and *Casuarius*, the other to the New Zealand forms. The latter again divided into two branches, one leading to the *Apterygidae*, the other to the *Dinornithidae*. Of this family *Dinornis* and *Emeus* are regarded as having diverged most widely from the ancestral type, which is probably most nearly represented by *Mesopteryx*. This view differs from that of Burckhardt mainly in the refusal to admit a common ancestry of *Struthio* and the *Casuariidae*, otherwise it is in general agreement with it, and is supported by the geographical distribution of the various forms. Unfortunately palæontology throws little or no light on the history of the *Struthious* birds, no fossil form that can be referred to that group with certainty being known from strata older than

the Pliocene. It is true that many extinct birds, as, for example, the *Gastornithidæ* and *Stereornithes*, have been referred to it, but in no case does it appear probable that we have to do with either actual ancestors or even offshoots of the ancestral Struthious stock. So far, therefore, as palæontology is concerned we have no means as yet of determining the relations of the Ratitæ either with one another or with other birds, and it is on such studies of the comparative anatomy of the various groups, as that given by Professor Parker in the case of the skull, that we must rely for information on this point.

Numerous papers have appeared lately dealing with the vexed question of the date of extinction of the Moas, and the points of view from which the problem has been attacked are very numerous. On the whole the evidence brought forward seems in favour of the view, so ably advocated by Dr. H. O. Forbes and others, that these birds have died out comparatively recently, and that their extinction is mainly due to the persecution they suffered from the Maoris, who hunted them down for food, and probably also destroyed their eggs. One of the reasons for believing that they survived till quite lately is the occurrence of portions of their bodies with dried flesh and feathers still adhering, several additional instances of which have been brought to light during the last year or so. Hamilton (29) has given a very interesting account of the various finds of Moa feathers, and more particularly of one which he himself investigated. In this case a large quantity of feathers, probably belonging to a species of *Megalapteryx*, were found in a cavern near the head of the River Waikaia, where a leg of the same bird with the flesh and skin still adherent had previously been discovered.

Some important discoveries of remains of extinct birds other than the Moas have been recently made in the New Zealand region. In a fissure in the limestone at Castle Rocks, Southland, Hamilton found an immense quantity of the bones of birds which appear to have fallen into the opening as into a pit-fall; though this can hardly have been the case with the large extinct eagles, *Harpagornis*, remains of both species of which occur. The remainder are nearly

all flightless forms, including *Anomalopteryx*, a large species *Fulica*, much like that found in the Chatham Islands (see below), a small Weka-rail, *Aptornis*, *Notornis*, and several others. An account of these, together with elaborate tables of measurements of the limb bones of some of them, will be found in Hamilton's paper (30).

The most important of all the recent discoveries in this region is, without doubt, that made by Dr. H. O. Forbes. In 1892 (32) he announced in *Nature* that he had received from the Chatham Islands (about 500 miles east of New Zealand) a skull of a large rail closely resembling the extinct *Aphanapteryx* of Mauritius; to this the name *Aphanapteryx Hawkinsi* was given. A large collection of bird remains, subsequently obtained from the same locality, contained all the more important bones of many individuals not only of this species, but also of several other extinct forms. Among the more notable of these were a large Coot, *Fulica chathamica*, very similar to the Mauritian species, *F. Newtoni*; a new type of Crow, *Palæocorax moriorum*, said to be most nearly related to the Gymnorhine group; an extinct Swan, *Chenopsis*, besides several other species, most of which are still inhabitants of the Islands. Several of the extinct forms have not yet been described, but of *Aphanapteryx Hawkinsi* and *Palæocorax moriorum* a short account was published in the *Ibis*. At the same time a new genus, *Diaphorapteryx*, was established for the reception of the former species. Subsequently, however, the new name was withdrawn, and Forbes expressed his conviction that the Chatham Island and Mauritius birds are not generically distinct, and must, therefore, both be referred to *Aphanapteryx*. This opinion he defends in a short paper (34), illustrated by figures of the humerus, sternum, and premaxillæ of the two forms.

In a paper by the present writer (35), on the osteology of the Chatham Island bird, a number of differences between it and *Aphanapteryx broeckii* are pointed out; and some of them, as, for example, the great dissimilarity between the metatarsi, are clearly of generic value, so that the name *Diaphorapteryx* was again adopted.

The assumed generic identity of these two forms was the most important new evidence brought forward by Forbes in his paper supporting the hypothesis of the former existence of an Antarctic Continent; but in the paper just referred to (35) it was shown that, as far as the birds are concerned, there is no evidence that the Chatham Islands have been united with any land area, and that the presence of two similar flightless rails on two islands remote from one another is no proof of any former land connection between them. In such a case it seems far more reasonable to suppose that both the islands may have been colonised by the same or allied forms of flying rails which have subsequently lost their powers of flight, owing to the very fact of their insular conditions of life. An instance of this on a smaller scale is found in the case of Tristan d'Acunha and Gough Islands, which are about 200 miles from one another and about the same distance from the Cape of Good Hope. Each of these islands is inhabited by a distinct species of *Gallinule* (*Porphyriornis*), which closely resemble one another and are incapable of flight; yet no one has suggested that on that account these islands were formerly united by land, either with one another or to Africa.

It is a fortunate coincidence that while the relationship between *Diaphorapteryx* and *Aphanapteryx* was still in dispute some additional remains of the latter were described. These bones, together with those of many other species, including the Dodo, *Lophopsittacus mauritianus*, *Fulica Newtoni*, etc., were described by Newton and Gadow in a well-illustrated memoir (36). Besides adding much to our knowledge of previously known extinct birds, the authors have been able to describe a number of new ones. They have also published a figure of the restored skeleton of the Dodo, which in several respects is more correct than those which have previously appeared. The whole of the remains described were obtained from the Mare aux Songes, from which previously a large quantity of Dodo bones had been collected. Besides the bones of birds those of the large extinct lizard, *Didosaurus*, and carapaces of Tortoises were found.

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